

(5)

P.

Organic Functions —

&
Animal Functions —

Figure of Excretion!
already given —

Draper — all growth
involves oxidation —

[January 8, 1874.]

....The tendrils of climbing plants, as is well known since Mr. Darwin's discoveries, are continually making circuits to find something to cling to. The grape-vine tendril is among the slowest in this rotary motion, making a circuit once in about three hours. A recent writer in an English periodical notes the additional fact that if after about ten days the tendril finds nothing to cling to the motion not only ceases, as Mr. Darwin says, but soon after dies; whereas the one which finds something early in its search lives the entire season, dying only with the leaves as winter comes. Of course, this comes down to a question of nutrition. The Academy of Natural Sciences of Philadelphia, in a volume issued about ten years ago, has a paper to show why it is that grape vines do so much better when growing over trees than when trained to stakes or trellises. Referring to Darwin's discovery of tendril motion, he shows that all motion must take food to maintain it, and useless motion must be a heavy draft on the nutrition and consequent vital power of the vine. When running over trees, the tendrils find support as soon as formed, and thus a great waste of nutrition is arrested and more is afforded for regular growth. This explanation will, perhaps, meet this question of life or death in the tendrils referred to. The tendril, after a ten days' fruitless search for something to cling, to exhausts itself and perishes, and because it is thus exhausted it dies within so short a time.

Independent.

✓ January 8, 1874.]

period in the future, will be unwise to the very last degree. The temporary relief gained thereby will be greatly overbalanced by its certain evils. It would be legislation in exactly the wrong direction—so bad in policy, so false to solemn pledges, and so utterly without warrant in the Constitution as to amount to a virtual crime.

QUIET.

BY THE REV. F. A. NOBLE.

Soul, be quiet! Better shalt thou see
What lies wrapped in mystery,
What doth mean thine agony
Waiting thus than searching ceaselessly.

Soul, be quiet! Better shalt thou know
How God's grace doth overflow,
How His peace He doth bestow
Than by anxious running to and fro.

Soul, be quiet! Nigh are things the best;
Faith the simplest bringeth rest;
Trusting hearts are surely blest;
Loving truly is the crown of quest.

TWO SERMONS OR ONE

BY THE REV. J. M. BUCKLEY.

THE propriety of dispensing with one of the Sabbath sermons has been under dis-

force &
digestion.

CHAPTER IV.

ORGANIC FUNCTIONS.

Two classes of functions (meaning by function action, operation) are performed by organs or apparatus in the animal body. One class is of actions common, in nature though not in method, to plants and animals. These are the functions connected with the *nutrition* of the organism; *organic* or *vegetative* functions. Such are absorption, assimilation, circulation of fluid, aeration, secretion, and reproduction. Others are entirely peculiar to animals; as sensation and spontaneous locomotion. These are *animal* functions, or functions of *relation*.

Comparison of Animals and Plants.

The differences between animals and plants are several. Plants are without most of the organs which the movements and endowments of animals require; as the stomach, liver, heart, etc. The *chemical composition* of the tissues of plants is simpler. Plants require *inorganic* matter for their *food*; as, carbonic acid, ammonia, potassa, etc.; animals must have *organic* matter; as, what we call our vegetable and animal food. Plants may thus be said to *prepare* organizable material for animals. Animals *elaborate* it further for their own substance, and then, by various actions, *restore* it again to the inorganic world. Water, though an inorganic substance, is a common vehicle for both. So, we find *water*, *carbonic acid*, and *ammonia* to be typical inorganic materials absorbed by plants through their leaves and roots, to be assimilated in the sap, and organized into stem, leaves, flowers, etc. Again water, carbonic acid, and ammonia are common and representative results of life-processes in animals, *after* organization has made them effete and thrown them out in excretions and exhalations.

Animals and plants both require *aeration*. But their action upon the air is different, even opposite. During the daytime, plants absorb carbonic acid from the air, and give out oxygen. Animals absorb oxygen, and return carbonic acid.

Sensation and locomotion are altogether animal functions. Yet, apparent exceptions to this exist; as, in the shrinking of the sensitive plant when touched, the closing together of the leaflets or lobes at the base of the leaf of the Venus' fly-trap, rhythmic movements of the stems of plants called *oscillatoriae*, and actual loco-

power to move or respond -
glands, thus serving to meet or respond -
Drosera (liverwort) glands thus serving to meet or respond -

top * An electric current, like musc. current, discovered (1873) by Burdon Sanderson in fly trap

motion of the zoospores (germinative seed-like particles) of Algæ. These are difficult of precise explanation; but it is evident that they are not the same in nature as the sensibility and truly spontaneous locomotion and other varied movements of animals. In their lowest and simplest forms, animals and plants approach each other very closely; so much so that doubt exists, in certain instances, to which kingdom to refer some of them. Some naturalists (Cassin and Wilson) have proposed, therefore, a third intermediate kingdom of *primalia*. *Haeckel later. & Owen*

The *animal* functions, sensation, and spontaneous motion, are called functions of *relation*, because they bring the body into relation with the external world, and its own different parts with each other.

Man, as an animal, resembles in general structure the other animals of the class *Mammalia*, *i. e.*, those who suckle their young.

Fig. 111.



HAND OF MAN AND OF ORANG.

But he has some peculiarities, which, apart from his higher mental and spiritual endowments, separate him, even, from the apes and other *quadrumana*, which resemble him most. These are, in brief, the erect posture, curves of the spine, width and capacity of the pelvis, depth of the socket of the hip-joint, long legs and short arms, wide and strong knee-joint, firmly arched foot, backward-projecting heel, prominent chin, even rows of teeth, absence of intermaxillary bone in the upper jaw in the mature skeleton, head balanced *equally* upon the spine, large head and brain, speech, laughter, and tears.

"Man's place in nature", according to Huxley.
 "Descent of Man", on the theory of Darwin.
Ascent of Man, on theory of creative evolution.

Classification of Animal Kingdom

(for reference to compar. physiology)

[See Marshall or Huxley for new system.]

Cuvier's:

Invertebrata & Vertebrata.

Added later, - Protozoa.

Invertebrates =

Radiates,

Molluscs,

Articulates.

vertebrata

1. Mamm., Aves, Rept.,
Amph., Fishes.

2. Mollusca; Cephalop.
Platyp., Pulmonat.

3. Branchiostom.,
Lamellibranch.

Vertebrates =

Fishes,

Reptiles,

Birds,

Mammals.

3. Mollusca,
Ascidacea, Brachiopoda,
Polysoda.

4. Amphibia,
Insecta, Arachnida,
Crustacea.

5. Amphibia,
Arachnida, Crustacea,
Polysoda, Scolida, Echin.

6. Coelenterata,
Protozoa.

Mammals =

(Not Pachyd.
just erect.)

divided
by
Cuvier!

Hoofed Quadrupeds, as Ox, sheep,
dog.

Clawed Quadrupeds, as Cat, squirrel,
beaver.

Pouched mammals, as opossum.

Bats, - winged mammals.

Whales, - aquatic mammals (including porpoise, dolphin).

Four Handed Mammals -

Bimana = Man

Complication & Cephalization = rank.

Vert.

Vert. Fish, Amph., Rept., B., Mamm.

Oyster, Snail

Cellulose

Moll

Moll

Ascid, Brachyopod

Polysoda

Moll.oid

Art.

Worms, Insects

Annulosa

Lebellers

Tapering, Thuidium

Annuloida

Rad.

Starfishes

Colent.

Prot.

Corals, Sea Anemones

Protosoa

Monera

Sponges, Infusoria

Bimana - Man

Quadruman Monkeys

Chiroptera Bats

Carnivora Cats

Insectivora Moles

Ruminantia Ox

Rodentia Squirrel

Edentata Anteater

Pachydermata Elephant

Cetacea Whale

Marsupialia Opossum

Monotremata Platypus

Vertebrata - Fish, Amph, Rept, B. Mam

Mollusca - Oyster, Snail, Cuttlefish

Molluscoria - Ascid - Brachiop. - Polyp

Arthropoda - Worms, Insects - Lobsters

Amphibia - Staffed - Tapin - Trichina

Colubridae - Jelly F. - Corals - Actinia

Protista - Mosses - Spores - Infusoria

Erect - Spine - Head - Ball
Polio - Sack - Knee - Foot
Lungs - Mega - Tooth - Skin
Polmer,
Horn - Hand

No.

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⑥

P.

Special Physiology

Alimentation

After General Biology
finished

Great Facts in Comparative Biology.

1. Homology: Unity of Plan, e.g. ^{arm & hand} man, ape, mole, cat, horse, ox, bat, whale.
2. Succession in Rank.
Complication & Cephalization.
3. Succession in Embryonal Development.
"Each individual represents the development of its race."
Haeckel.
4. Succession in Geological Time.
On the whole, ascent.
5. Existence of Comprehensive Types & Specialization
6. Gradations among all Types.
→ Rediments.
7. Adaptation: showing Purpose, or Design.
Sir T. Watson - "eye of the mind."

Theory most probable: Derivation,

Creative ~~in~~ Evolution: i.e. Each type,

after being made, is taken as a means towards the creation of the next above it; the ascent, however, being ^{continued or renewed} effected by the purposive action of Divine power, that power being thus recognized from the beginning to the end of the series of organic development.

Life of Mind - Spirit. Soul Human!
Ascent of Man - Soul Human!

The Fine Old Atom-Molecule.

AIR—"The Fine Old English Gentlemen."

(To be sung at all gatherings of advanced Sciolists and
"Scientists.")

We'll sing you a grand new song, evolved from a 'cute
young pate,

Of a fine old Atom-Molecule of pre-historic date,
In size infinitesimal, in potencies though great,
And self-formed for developing at a prodigious rate—
Like a fine old Atom-Molecule,

Of the young World's proto-prime!

In it slept all the forces in our cosmos that run rife,
To stir Creation's giants or its microscopic life;
Harmonious in discord, and co-operant in strife,
To this small cell committed, the World lived with his
Wife—

In this fine old Atom-Molecule,

Of the young World's proto-prime!

In this autoplasmic archetype of Protean proteïn lay
All the humans Space has room for, or for whom Time
makes a day,

From the Sage whose words of wisdom Prince or Parlia-
ment obey,

To the Parrots who but prattle, and the Asses who but
bray—

So full was this Atom-Molecule,

Of the young World's proto-prime!

All brute-life, from Lamb to Lion, from the Serpent to
the Dove,

All that pains the sense or pleases, all the heart can
loathe or love,

All instincts that drag downwards, all desires that up-
wards move,

Were caged, a "happy family," cheek-by-jowl and
hand-in-glove,

In this fine old Atom-Molecule,

Of the young World's proto-prime!

In it Order grew from Chaos, Light out of Darkness
shined,

Design sprang up by Accident, Law's rule from Hazard
blind,

The Soul-less Soul evolving—against, not after, kind—
As the Life-less Life developed, and the Mind-less ri-
pered Mind,

In this fine old Atom-Molecule,

Of the young World's proto-prime!

Then bow down, Mind, to Matter; from brain-fibre
Will, withdraw;

Fall Man's heart to cell Ascidian, sink Man's hand to
Monkey's paw;

And bend the knee to Protoplast in philosophic awe—
Both Creator and Created, at once work and source of
Law,

And our Lord be the Atom-Molecule,

Of the young World's proto-prime!

—[Punch.]

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constant use of them for a number of years,
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Smith, General Bookkeeper Metropolitan

on Discount Clerk Metropolitan Nat. Bk.

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President American Exchange Nat. Bank.

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BAI

SAMUE

Democritus at Belfast.

[See report of Prof. Tyndall's inaugural discourse to the British Association.]

Tyndall, high-perched on Speculation's summit,
May drop his sounding line in Nature's ocean:
But that great deep has depths beyond *his* plummet—

The springs of law and life, mind, matter, and motion.

Democritus imagined that the soul
Was made of atoms, spheric, smooth and fiery;
Plato conceived it as a radiant whole—
A heavenly unit, baffling man's inquiry.

Indolent gods, immeasurably bored,
Beyond the blast of Boreas and Eurus,
Too lazy Man to punish or reward—
Such was the Heaven conceived by Epicurus

If, as the wide observant Darwin deems,
Man be development of the Ascidian,
Methinks his great deeds and poetic dreams,
Scarce square with his mollusious pre-meridian.

But, even as Milton's demons, problem-tossed,
When they had set their Maker at defiance,
Still "found no end, in wandering mazes lost,"
So is it with our modern men of science.

Still in the "open sesame" of Law,
Life's master-key professing to deliver,
But meeting, with deaf ear or scorn-clenched jaw,
Our question "doth not law imply law-giver?"

Betwixt the Garden and the Portico,
Thou, vacillating *savant*, often fittest;
And when we seek the source of law to know,
Giv'st us a phrase, "survival of the fittest."

Pray, who may be fittest to survive
The spark of thought for coming time to kindle—
The sacred fire of science keep alive?
Plato, Agassiz, Humboldt, Huxley, Tyndall?

If Tyndall's last word be indeed the last,
Of Hope and Faith hence with each rag and tatter!

A black cloud shrouds our future as our past;
Matter, the wise man's God; the crowd's—no
Matter!

—Punch.

In inky skies
Search in the starry lining;
And in her heart
Sets two apart,
That seem forever shining.

She thinks they stand,
Hand clasped in hand,—
Dear Bess and little Alice;
And night and day
Make light the way
To her dear Father's palace.

—*Oliver Optic's Magazine.*

"Down Went the Royal George."

Many years ago an English fleet lay at anchor in the roadstead at Spithead, near Portsmouth, England. The finest ship in that fleet was "The Royal George." She was the admiral's ship, and carried a hundred guns.

Just as everything was on board and she was ready to go to sea, the first lieutenant discovered that the water-pipes were out of order. In order to repair them, it was not thought necessary to put the ship into the dock, but only to heel her over till that part of the hull where the pipes were was brought above the water.

Heeling a ship over, you know, is making her lean over on one side. The larboard or left-hand guns are run out from the port-holes as far as possible; and then the starboard or right-hand guns are run over towards the other side. This makes the vessel heel down toward the water on one side, and rise high out of the water on the other.

A gang of men from the dockyard was sent to help the ship's carpenters. The workmen reached the pipes of "The Royal George," and made the needed repairs. But, just as they had done so, a lighter, or large open boat, laden with rum came alongside.

Now, the port-holes on the lower side of

A DIDACTIC ODE.—*To be sung to the tune of "Guy Faux."*

Ours is a wise and earnest age, an age of thought and science, Sir;
To error, ignorance, and bliss we fairly bid defiance, Sir.
"Professors" everywhere abound, both in and out of colleges,
And all agog to cram our nobbs with "isms" and with "ologies."

Bow, wow, wow,
Tol de riddle, tol de riddle,
Bow, wow, wow.

Philosophy, as you're aware, material and mental, Sir,
At one extreme is "Positive," at t'other "Transcendental," Sir;
And each of us who in these days would speculate "en règle,"
If he can't run the rig with Comte, must take the tip from Hegel.
The fundamental problem which, debated now for ages, Sir,
Is still attacked and still unsolved by all our modern sages, Sir,
Is, if an effort I may make a simple form to throw it in,
Just what we know, and why we know, and what's the way we know
it in.

We can't assume (so Comte affirms) a first or final cause, Sir.
Phenomena are all we know, their order and their laws, Sir;
While Hegel's modest formula a single line to sum in,
Is "nothing is and nothing's not, but everything's becomin'."
"Development" is all the go, of course, with Herbert Spencer,
Who cares a little more than Comte about the "why" and "whence,"
Sir.

Appearances, he seems to think, do not exhaust totality,
But indicate that underneath there's some "Unknown Reality."
And Darwin, too, who leads the throng "in vulgum voces spargere,"
Maintains Humanity is naught except a big menagerie,
The progeny of tailless apes, sharp-eared but puggy-nosed, Sir,
Who nightly climbed their "family trees," and on the top reposed, Sir.
There's Carlyle, on the other hand, whose first and last concern it is
To preach up the "immensities" and muse on the "eternities;"
But if one credits what one hears, the gist of all his brag is, Sir,
That "Erbwurst," rightly understood, is transcendental "Haggis," Sir.

Imaginative sparks, you know, electric currents kindle, Sir,
On Alpine heights, or at Belfast, within the brain of Tyndall, Sir;
His late address, some people hold, is flowery, vague, and vapory,
And represents the "classic nude" when stripped of all its "Draper"-y.

Professor Huxley has essayed to bridge across the chasm, Sir,
'Twixt matter dead and matter quick by means of "protoplasm," Sir,
And to his doctrine now subjoins the further "grand attraction"
That "consciousness" in man and brute is simply "reflex action."

Then Stanley Jevons *will* contend in words stout and emphatical
The proper mode to treat all things is purely mathematical;
Since we as individual men, communities, and nations, Sir,
Are clearly angles, lines, and squares, cubes, circles, and equations, Sir.

George Henry Lewes, I'm informed, had "gone off quite hysterical"
About that feeble, foolish thing, the "theory Metempirical;"
And only found relief, 'tis said, from nervous throes and spasms, Sir,
By banging straight at Huxley's head a brace of brand-new "plasms,"
Sir.

Such are the philosophic views I've ventured now to versify,
And, if I may invent the term, in some degree to "tersify."
Among them all, I'm bold to say, fair room for choice you'll find, Sir,
And if you don't, why then you won't and I for one sha'n't mind, Sir.

which they act. The molecule of mercury is massive, hence its action may be expected to be not only general, but specific. 3. The salts of those agents which form stable compounds with albuminous substances are retained for a comparatively long period within the body. The salts of mercury form very stable compounds with albumen, and it is known to be retained for a long period.

After absorption, mercury has a preferential action upon the white tissues of the body, more especially the adenoid tissue, which it stimulates to increased activity. It does most good in chronic indurations and effusions. It is used in syphilis during the induration of the primary sore, and in the secondary stage after the fever has subsided. It does no good in the tertiary symptoms, because the disease is then acting on tissues for which mercury has no affinity.

MULTILOCULAR SERO-CYSTIC OVARIAN TUMOR SUCCESSFULLY TREATED BY MEANS OF THE ELECTRO-PUNCTURE (*The Chicago Medical Journal*, September, 1874). —Dr. Plym S. Hayes reports the case of an unmarried woman, æt. 40, who suffered from an abdominal tumor which she had first discovered about four months previously.

The abdomen was as large as that of a woman five months pregnant. The growth extended an inch and a half above the umbilicus when the patient was supine. As the abdominal walls were quite thin, the outlines of the tumor were easily distinguished. Three lobes could be distinctly outlined: one in the right iliac fossa, which had attached to its inferior portion a pedicle passing into the cavity of the pelvis; one to the left of the median line, connected by a band to the first-named lobe; and a third—the original tumor—below this band and just above the pubis: this lobe was felt to be nodule.

Fluctuation could be distinguished in the first two when palpation was employed over each separately, but not when the hand was placed over the one and the other percussed.

Digital examination revealed the fact that the os uteri was directed backward, pressed firmly against the rectum, and congested. Bimanual examination demonstrated that the tumor was not uterine. The sound was introduced into the uterus, and the tumor moved from side to side without producing any marked movement of the sound. The uterus was of normal depth.

Local anæsthesia having been produced by means of ether-spray, two needles were introduced, one into the right cyst, the other into the left, and the current was applied for a few minutes. No trouble followed. This operation was repeated three times during the following month, general electrical treatment being continued during the intervals. No unpleasant effects were at any time experienced, and the treatment resulted in the entire disappearance of the tumor and the complete

Begin 2nd Review, 71. To Animal Heat, p. 250.

PART II.

SPECIAL OR FUNCTIONAL PHYSIOLOGY.

CHAPTER I.

ALIMENTATION.

THIS comprehends, after *prehension*, or the taking of food, *mastication*, *insalivation*, *deglutition*, *digestion*, *absorption*, *assimilation*, and, as the final result of all, *nutrition*.

Mastication and Insalivation.

These are accomplished together; by the muscles of the jaws, which make the teeth divide the food, acting at the same time with those of the tongue, to mix the saliva with it. The temporal, masseter, and pterygoid muscles are those of mastication.

The *salivary glands* are the *parotid*, *submaxillary*, and *sublingual*. Different opinions exist as to the respective actions of their secretions. The *mucus* of the mouth, from numerous follicles, is added to them in mastication. It seems to be shown, that the mixed fluid will, out of the body, act upon starch, converting it first into dextrin, and then into sugar. Several experimenters have found saliva from the different glands to act in the same manner. As this effect is prevented by the presence of acid, it appears to be entirely arrested in the stomach. Dr. Dalton concludes that the saliva does not, therefore, digest starch; but that its solution is effected in the small intestine by the pancreatic juice. Dr. A. Flint, Jr., asserts the more generally held opinion, that at least a considerable part of the starch of food is changed into sugar by the saliva. This fluid is peculiar in containing, though not invariably, *sulpho-cyanogen*. Its active principle, *ptyalin*, or *salivin*, is a nitrogenous substance, analogous in composition and catalytic agency, to *diastase* of the seeds of plants; in which the change from starch to sugar is effected at a certain stage of germinal development. — *Chica cascada*.

Deglutition.

When the "bolus" of masticated food is forced by the muscles of the tongue and palate through the fauces and over the epi-

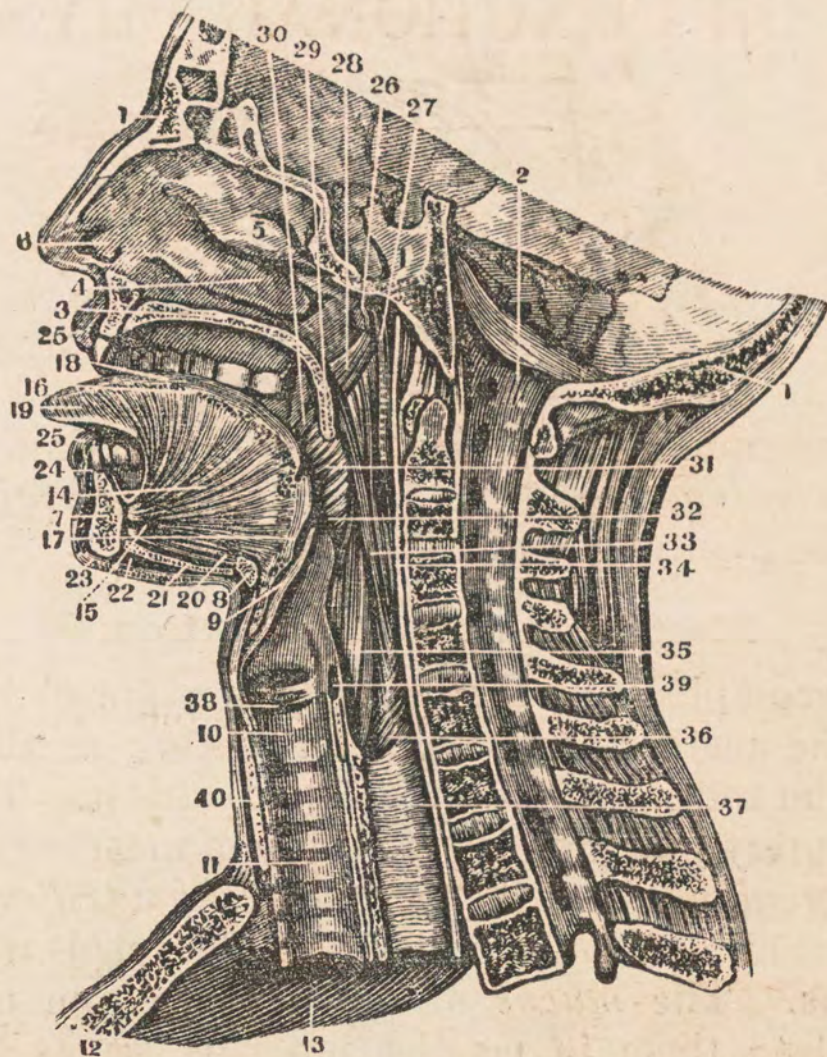
Chica cascada — a sour taste.

Animals, see next blank page

Saliva also aids deglutition; its mucus part may do that.

glottis into the pharynx, the constrictor muscles of the latter carry it downward; the contraction of the œsophagus upon it conveys it through the cardiac orifice of the stomach into that organ. An indispensable part of the process of deglutition is the adjustment of the *epiglottis*, as a lid to the larynx, which is by it protected

Fig. 112.



DEGLUTITION.—1, 1. Section of head. 2. Spinal canal. 3. Hard palate. 9. Epiglottis. 11. Trachea. 30-34. Pharyngeal muscles. 35-37. Esophagus.

from the entrance of what is swallowed; which must pass over the glottis, as the windpipe lies in front of the pharynx. If one breathes (as in laughing) at the moment of swallowing, *choking* ensues, from a morsel or a drop of liquid going “the wrong way.” The irritability of the larynx is itself protective, by the violent spasmodic efforts produced, expelling the intruding substance. When we swallow, the pharynx and larynx are *raised up*, by the stylo-pharyngeus and superior constrictor muscles.

Gastric Digestion.

Entering the stomach, the food is still kept in motion; being carried slowly around by a sort of churning movement of the muscular fibres of the stomach. Thus the *gastric juice* is thoroughly mixed with it. This fluid consists of an acid solution containing *pepsin*. The acid is either chlorohydric (muriatic) or lactic acid; sometimes an acid salt of phosphoric acid. Dr. Dunglison found

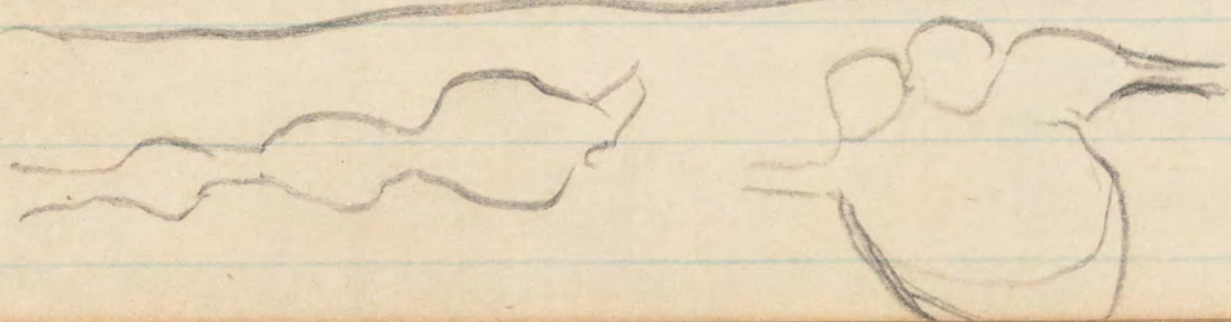
(From previous page)

Comp. physiol. of prehension
amphib. (according to Leidy, sometimes surrounding food with ectosarc)
Elaph. - Tapir - Camel
Butterfly - Mosquito - beetle - bee -
Bird; claw - bill - (woodpecker, hummingbird)
Claws of Carnivore - Tongue of Antelope
Hand of man (& apes)

Teeth: & even
Many of sharks & other fishes -
(Tortoise none): Snakes - fangs -
Carniv. type - Herbiv. - Ruminant
Rodent Omniv. - Bear - Rat - Hog - man -

Alim. canal -

Lowest to body sac? Can't compare
the specialization -
Insect - Bird - Ruminant
Plants similar ascending - as
liver, etc



↓ ↓
* ~~Heat, strong alcohol, Stile,~~
~~precipitate pepsin from gastric juice.~~

Pepsin formed in gastric glands slowly.
Acid, secreted only at times of digestion.

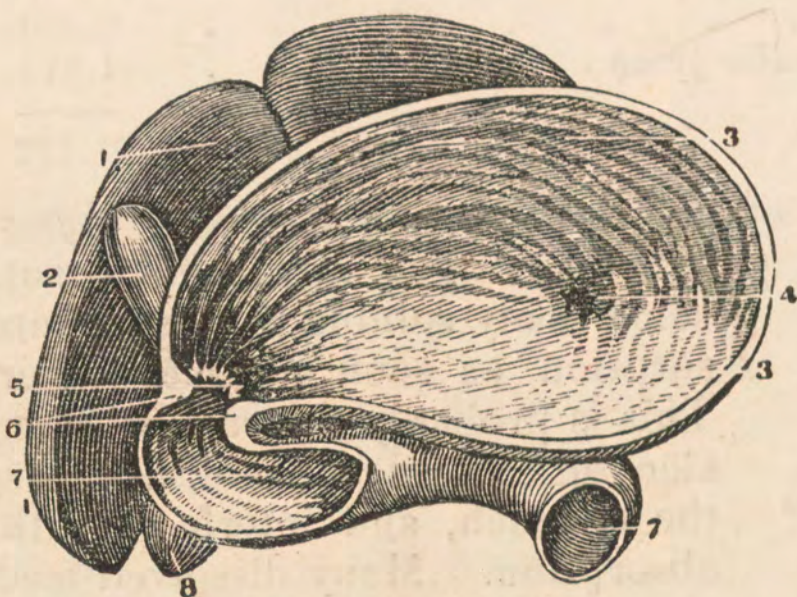
but still is by strong alcohol.

albuminose is not coag. by heat, acids, or ferrocyanide.

Albumen is not diffusible; albuminose is so.

chlorohydric acid in Alexis St. Martin's¹ stomach, in 1833. The same subject was experimented upon by Profs. R. E. Rogers and F. G. Smith in 1856; these observers concluding that the principal agent of digestion was lactic acid.

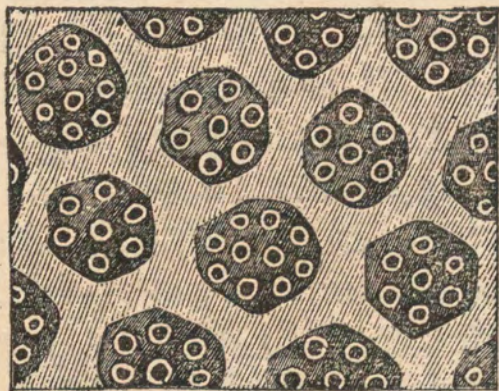
Fig. 113.



THE STOMACH.

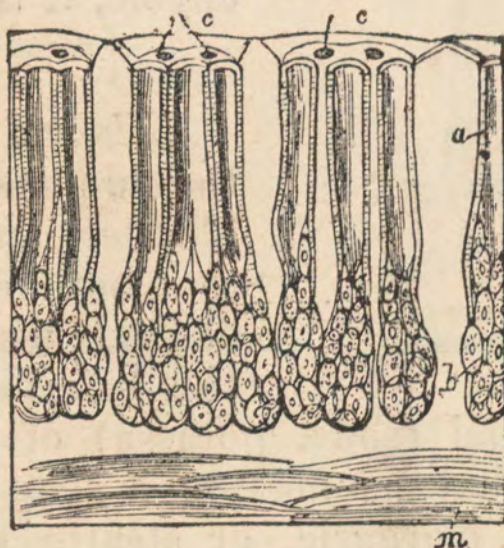
Pepsin is a nitrogenous body, considered to be analogous in its mode of action to the fermenting principle of yeast, or to the

Fig. 114.



MUCOUS MEMBRANE OF THE STOMACH,
MAGNIFIED.

Fig. 115.



PERPENDICULAR SECTION OF THE SAME —
a. Neck of a gastric tubule. b. Fundus.
c. Orifices of tubules. m. Muscular coat.

diastase of plants, already alluded to. Being complex, it is prone to chemical change; and, by contact, institutes the *same kind* of chemical movement among the particles of food with which it is mixed. The gastric juice is believed to digest especially *nitrogenous* food; as the lean of meat, the gluten of bread, and the casein of milk. The products of this digestion have been, by Lehmann, called *peptones*; that of albuminoid food, *albuminose*.

¹ A patient of Dr. Beaumont of Ohio, whose stomach was wounded by the bursting of a gun, leaving a permanent opening or fistula.

Medicinal Pepsin.

* Except musc. fibre not finished.

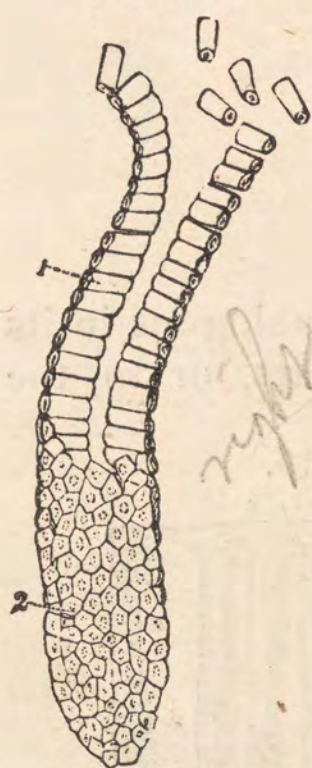
another case, a woman in Germany, 1854. Prof. Schmidt

Gastric juice is not present in any quantity in the stomach when it is empty; but begins to be secreted by its glands as soon as food is taken. The amounts of the digestive fluids secreted in a man in 24 hours are thus stated by Dr. Dalton:—

Saliva	.	.	.	.	.	.	2.880 pounds.
Gastric juice	.	.	.	.	.	.	14.000 "
Bile	.	.	.	.	.	.	2.420 "
Pancreatic juice	.	.	.	.	.	.	1.872 "
							21.172 "

The result of gastric digestion is called *chyme*. Besides the action of the gastric juice upon nitrogenous matters, no doubt some easily soluble substances are ready for absorption as soon as they enter the stomach.

Fig. 116.



FOLLICLES OF PIG'S STOMACH.

This is probably the case with sugar and dilute alcohol. *Strong* alcohol, as raw spirits, irritates the stomach, and interferes with secretion and absorption. Many dissolved medicines also are absorbed at once, into the capillary bloodvessels of the stomach.

The *pylorus* is a muscular valve constricting the left end of the stomach, so as to prevent the passage of undigested food. When reduced to chyme, it is allowed to pass into the duodenum.

Intestinal Digestion.

Bile and *pancreatic* secretion are poured into the duodenum by the ducts of the liver (and gall bladder) and pancreas. It is a common opinion that both continue and complete the digestion of food; especially *fatty* food. In two modes is this believed to take place. One by the alkaline material (soda, potassa) of the two secretions *saponifying* the fat, that is, making a soap by combining with the fatty acid, oleic, margaric, or stearic, etc. Soap is soluble in water, and thus absorbable; as fat or oil is not. Also, an *emulsification* or suspension takes place, like that made by mixing oil first with gum Arabic and then with water; so that in the state of minute subdivision, almost identical with solution, the oil may be absorbed. Dr. Dalton, however, does not admit that the bile takes part in digestion, although acknowledging that very little of it is excreted from the bowels, and that the larger amount of it not passing out must have *some* important function to perform before its re-absorption from the intestinal canal.

Absorption.

The pancreatic juice, containing the organic agent *pancreatin*, is considered by Dr. Dalton and others to *emulsify* fatty materials of food. By this process, and the continued action of the gastric

Its ingredients undergo change in the intestine, so as not to be detectable in the portal vein.

Various experiments are recorded, having for their object to determine the maximum degree of dilution. The research is not yet complete, but a remarkable result has been arrived at—viz. that the stomach of a dog in good condition requires 200 litres of water to bring out its full digestive powers. Such an infusion has been found to be capable of digesting 60,000 grammes of albumen.

Schiff's former researches with infusions of stomach led him to state that an infusion of one stomach might, under very favourable conditions, digest from 150 to 180 grammes of albumen—an amount which was considered by several physiologists as too high. The present results, therefore, are the more likely to draw attention.

pearance; others as being of a deep hazy red tint and slightly swollen; whilst a third class are said to be white with a very faint capillary tint; and, lastly, some are described as being quite white and atrophic. It would thus appear that the affection commences by inflammation and slight exudation, and ends in atrophy. Now this closely corresponds with the course of the disease known as descending neuritis, which is thus described by Mr. Soelberg Wells. "In the descending neuritis the tissue of the nerve is more diffusely clouded (than in the engorged papilla), but the swelling and redness of the disc are much less, and its tint is of a pink grey; the retinal arteries are diminished in calibre, but the veins are dilated and tortuous than in the engorged

THE ACID OF THE GASTRIC JUICE. — Whether the acidity of the gastric juice be due to lactic or hydrochloric acid is still an open question. The former view rests on the authority of Prout, Graham, Schmidt, and others, while the latter is maintained by Bernard. Rabuteau has investigated the point afresh, employing a new method which he describes in the *Comptes Rendus*. He obtains the juice from the stomach of a dog which has been allowed to fast for twenty-four hours, and has then been fed on bits of tendon. To the liquid, after filtration, pure quinia is added so long as it will dissolve. It is then dried *in vacuo*, and the residue treated, first with amylic alcohol, then with chloroform or benzine; the latter agents being able to dissolve many salts of quinia, while refusing to take up the mineral chlorides. On evaporation, the solvent leaves a pure hydrochlorate of quinia. Other analyses showed the absence of any trace of lactic acid. Quantitative determinations yielded 2.5 parts of hydrochloric acid in 1000 of gastric juice.

1876.

...bet, who has been engaged as a physician
years past on the French line of steamers between
Havre and New York, states, in the *Archives de
Médecine Navale*, that of the many remedies which
he has tried upon passengers suffering from "nau-
pathie" or sea-sickness, chloral is by far the best,
and is indeed very efficacious. Bromide of potas-
sium, which, before the introduction of chloral, was
the substance that did most good, is far too slow in
its effects, and requires to be given in too large
doses before any marked effect is produced, while
the quantity of water necessary to enable it to be
swallowed forms a serious obstacle to its employ-
ment in this affection. Chloral, on the contrary,
given in the form of syrup, in a dose of from 1
to $1\frac{1}{2}$ or 2 grammes, procures a calm and tranquil
sleep, on awakening from which the patient finds
himself, if not completely cured, at least in a state
of relative comfort. On the first day of the voyage,
this sleep should be at once secured by giving the
patient 1 gramme (15 grains) at a single dose, and
the following days $1\frac{1}{2}$ or 2 grammes may be given
... by taking ... spoonful of the syrup

9 Pancreatic juice transforms starch into sugar,
~~dissolves~~ ^{coagulated} albuminoid materials; especially musculine
Chiff found that, in animals having
fat or oil in their food, digestion of
the latter continued to be complete,
after the pancreas had been removed:

Yet other experiments, and the fact that
the pancreas is large in many carnivora,
make it probable that, as Bernard first suggested, the
pancreatic fluid emulsifies fat.



* Entero capillary venous absorption.

Beef essence & beef tea & dilute alcohol.

~~13~~ Diet of sick — especially in fevers.

⑦ Dalton denies that bile aids at all in digestion of starch, albumen or fat. But —

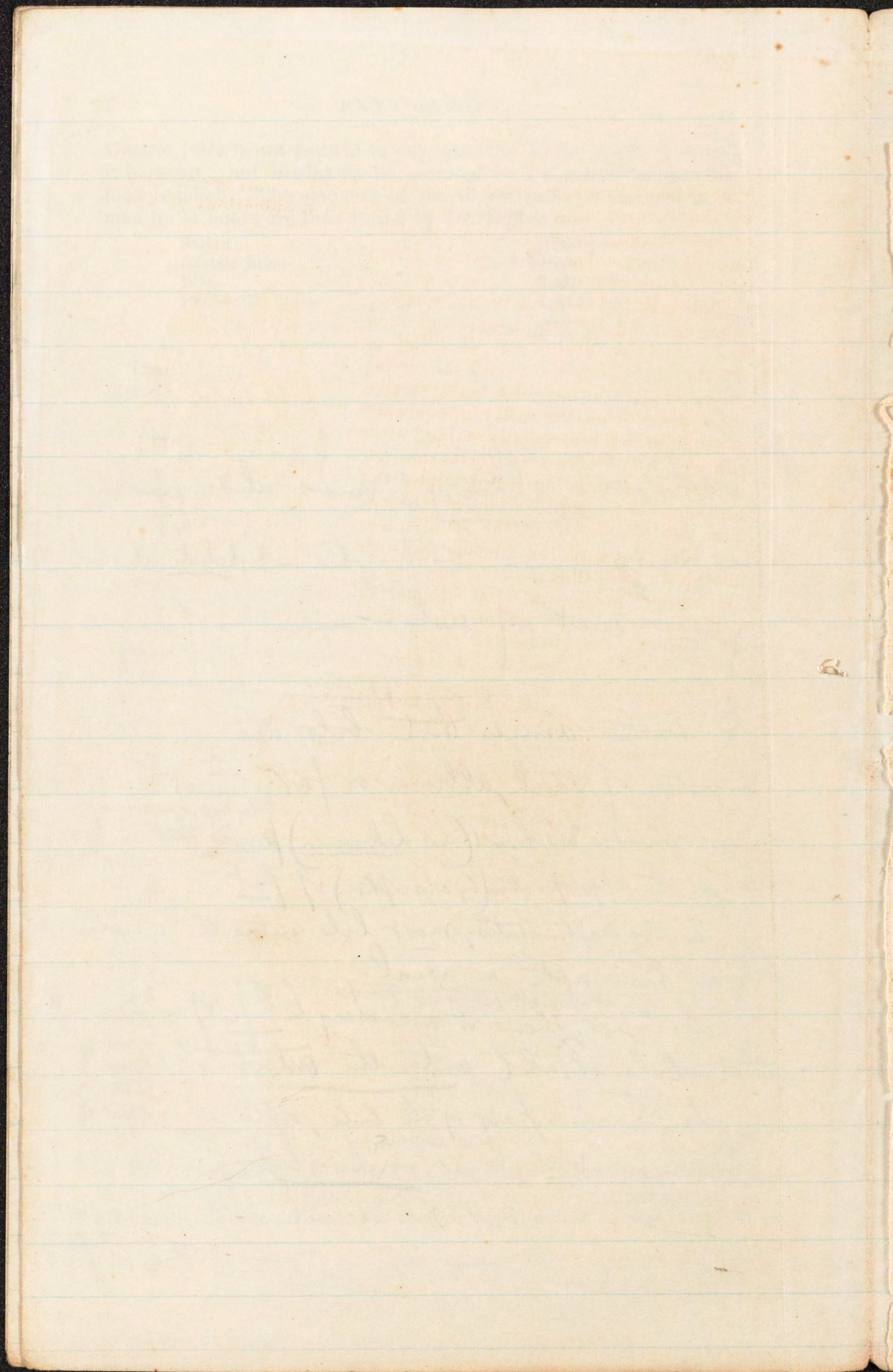
1. Bidder & Schmidt (see Lehmann) ^{by exp. on animals} proved that it does assist the appropriation (by absorption) of fat.

2. As Dalton states, most bile enters the intestine for an hour after a meal.

3. ^{at least 10 times performed} Exper. shows it necessary to life of an animal that bile should enter the intestinal canal.

4. Greater part of the bile, after mixing with the chyme & chyle, is reabsorbed from the intestine.

Prof. D.'s denial is therefore not sustained — although his exper. with bile on food in test tubes failed.



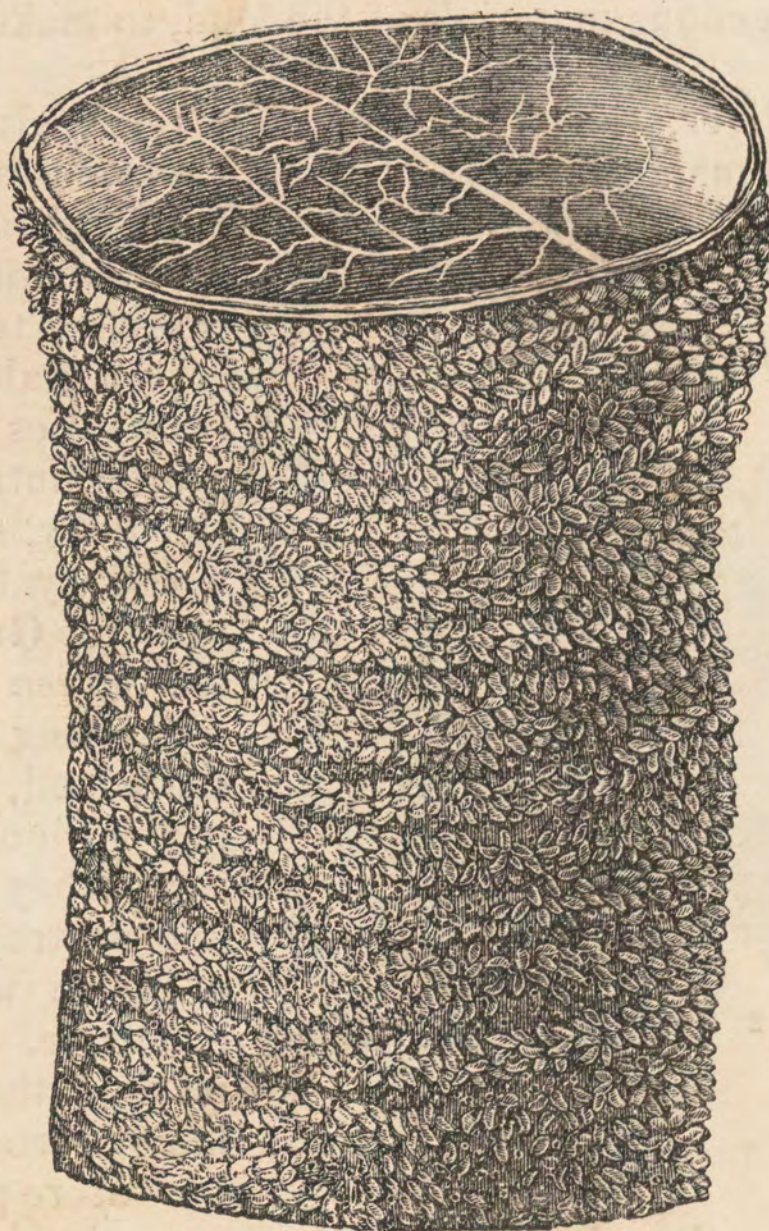
juice derived from the stomach, *chyle* is formed. This is absorbed by the *villi* or minute velvety tufts, of the terminations of the *lacteal* vessels. Each villus contains the loop-like beginning of a lacteal tube; and each is covered by a layer of epithelial cells. It is uncertain whether these cells fill by absorption and then burst into the interior of the villus, or whether they simply *transmit* the chyle; probably the latter. Lacteals receive their name from the milky appearance of chyle, which is especially marked after a meal. All of these vessels pass through mesenteric glands to empty into the thoracic duct. Besides lacteal absorption, the *bloodvessels* of the small intestine, like those of the stomach, absorb the products of digestion. The veins of the upper portion of the alimentary canal empty into the *portal vein*. This

Fig. 117.



VILLI OF INTESTINE.

Fig. 118.



PIECE OF ILEUM.

goes to the liver, subdividing into capillaries as it enters that organ. Probably the secretion of the *glands of the small intestine* (succus entericus) may have some digestive action; but it has not yet been demonstrated. Undigested food is, as refuse, conveyed, by the peristaltic action of the intestinal tube, through the ileo-colic valve to the large intestine, to be excreted as a part of the feces.

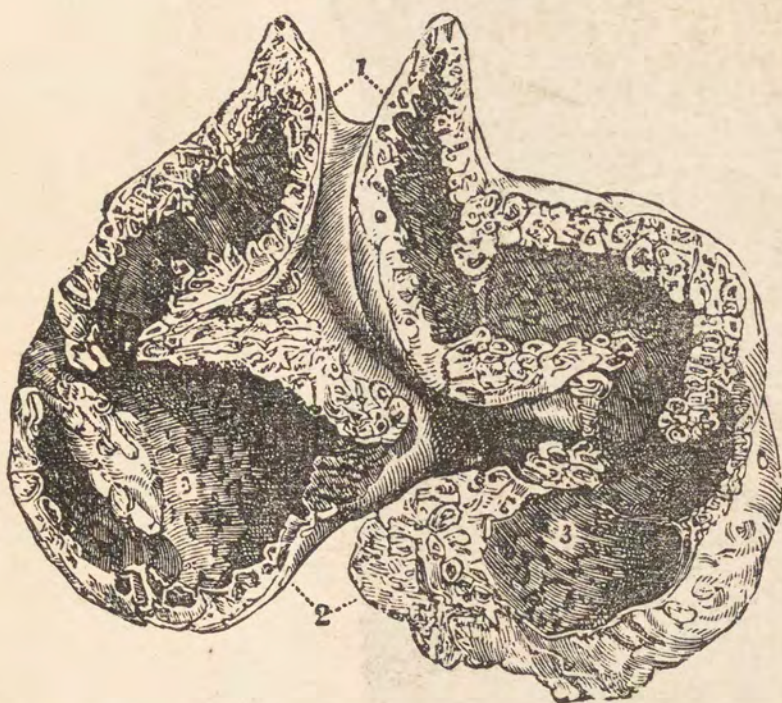
Peyer's glands probably lymphatic
Assimilation.

With good reason, this is ascribed as a principal function to the liver; through which so much blood, enriched, after eating, by the materials digested and absorbed, passes, entering by the portal vein. Exactly what is done in this process we cannot explain. After death, Bernard and others have found a *saccharine* substance, glucose, liver-sugar. Pavy asserts this to be a post-mortem educt. A sugar-producing substance, at least, glycogen (hepatin, liver-dextrin), must be admitted to be formed naturally in the liver. Its after destination is doubtful, except that, by the hepatic vein, it goes on toward the general circulation. Some believe that it acts as a "fuel for combustion," for animal heat, being "burned off" in the lungs. Dr. McDonnell has proposed the view that, in assimilation of blood brought by the portal vein, glycogen combines with nitrogenous materials of the food, to make plastic material for tissue.

Besides the liver, the *mesenteric glands* are almost certainly assimilating organs. Chyle is obviously altered by its passage through them. In foetal and infantile life the *thymus* and *thyroid* glands probably have the same use. The *lymphatic* glands are

supposed to restore to the lymph reabsorbed by the lymphatics (as the surplus of nutrition) all over the body, some qualities necessary for its farther utility. Gray ascribes to the *spleen* the office of regulating the quality of the blood, by producing new blood corpuscles when they are deficient, and destroying a portion of them when they are excessive. It may be remarked that this theory is not certainly established. More probable is the

Fig. 119.



THYMUS.

opinion that the spleen is a *diverticulum* or reservoir of blood, receiving it especially from the stomach when that organ is function-

More or less glycogen in liver according to food, especially starch or sugar. Glycogen is $C_6H_{10}O_5 = \text{Glucose} - H_2O$.
 $C_6H_{12}O_6$

....It has commonly been believed hitherto that the juice secreted by the intestine is alkaline, and not acid. M. Leven has recently pointed out in the French Academy of Medicine that physiologists have been in error on this point, because they generally experimented by tying a portion of the intestine at two points and then opening the part between to obtain the juice ; and this they found alkaline, because of the blood serum which under these conditions enters the intestine. By another method, which avoids this source of error, M. Leven finds the juice acid ; and he thinks the intestine the principal apparatus of digestion, the stomach being only secondary. The stomach merely commences the digestion of nitrogenous substances. It has no power either over fatty or starchy matters. He finds, too, that the function of transforming starchy matters into sugar, of making emulsions of fatty matters, and of producing peptone belongs to the small intestine alone.

1875.

perceives the thief's actions, he takes away the rest. He goes among the bad ones and joins the tribes of the Shasous and transforms himself into an Asiatic."

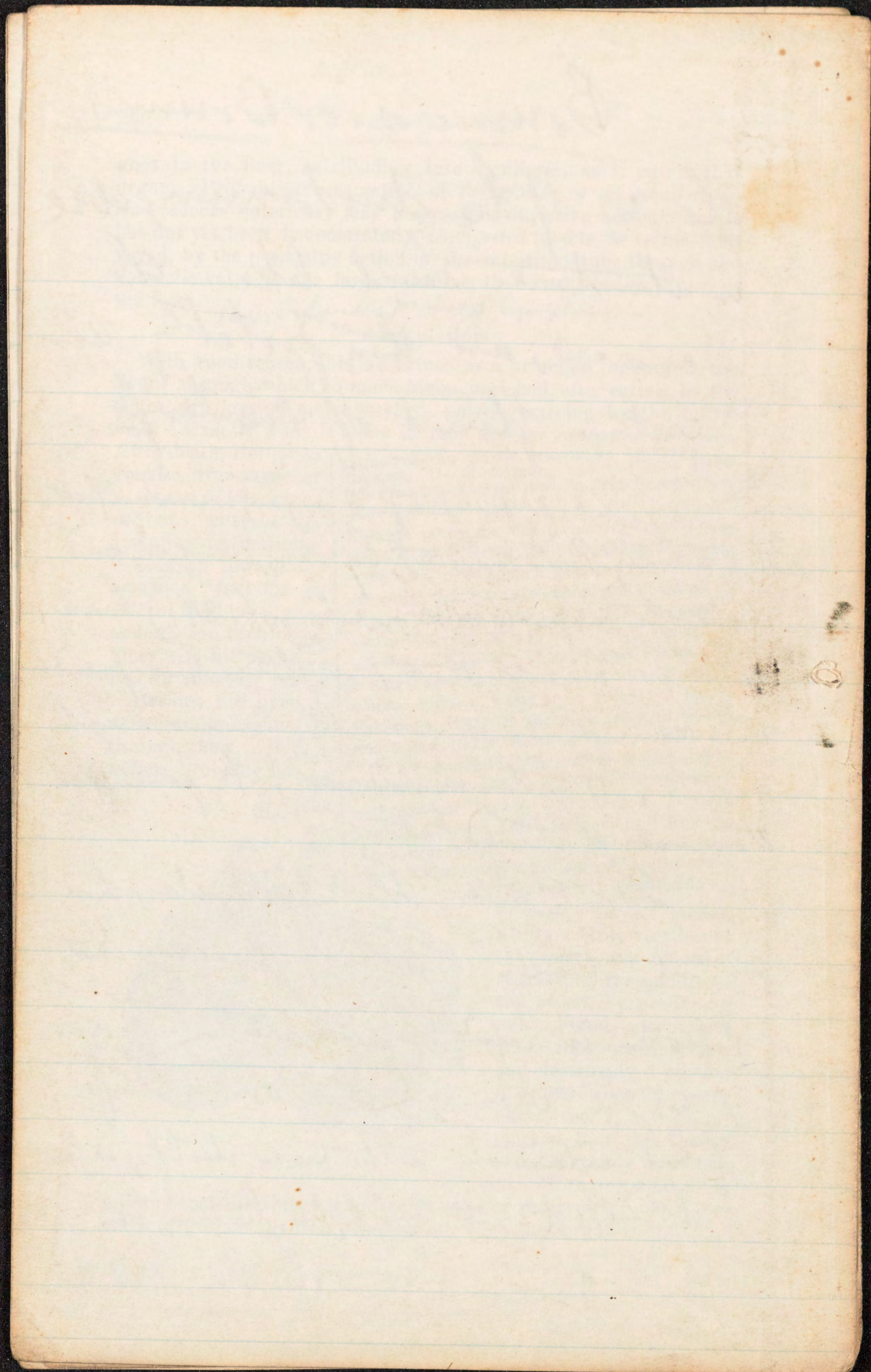
He next takes the coast, passing the "holy city Kapaon" (Gebal), Berytus, Sidon, Sarepta "the ford of Nazana" (across Dog River probably), and "Aoutou, neighbors of another city on the sea, Tyre the port is its name. Water is carried to it in barks; it is richer in fish than in sands." Then he goes across the country, coming now and then to a familiar place. Djaraou, a city he is ordered to burn. Pakaitana, Aksaph, the mountains of Ous and Ikama, Hazor, Hamath, Takar, Takar-A "the all-assembling place of the Mohars," J and Matamim. Then a different set of towns—the land of Takhis, Cofer-Marlon, Tamer Qodesh, Dapour, Adjai, Harnemata, "Keria Anab, near to Beith-Tuphar, Odullam and Tsiphoth, Khaouretsa, in the land of Aup, the image of Sina, Rohob, Beith-Sheal, Keriathaal, the

Brunners or Brunst
glands, of the duodenum, are
in structure much like the
pancreas; and they probably se-
crete a fluid of similar function.

Schiff failed to find sugar, immediately after
death, in the liver. Prof. Dalton, by very careful and
elaborate experiments on dogs (1871) has
satisfied himself that, at the earliest possible
time that the liver can be examined after
death, it contains sugar, $2\frac{1}{2}$ parts per
thousand of its substance.

Dr. Austin Flint, Jr., also, has
added strength to the conclusion, that
glycogen is rapidly convertible into sugar,
& that this change occurs during life;
if not extensively in the liver itself, at least
in the blood not long after leaving it.

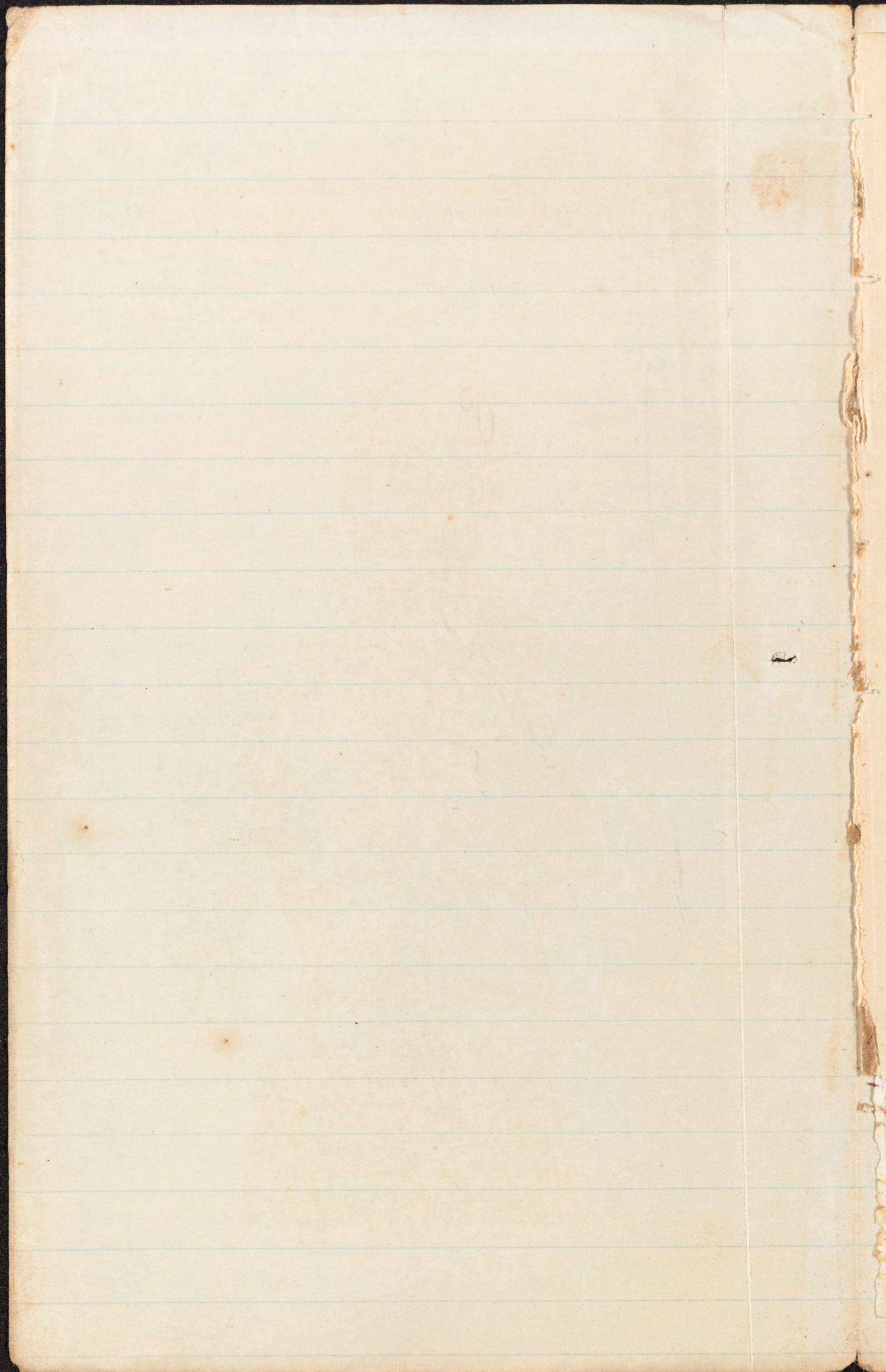
Increase of flow of blood through the liver
increases the amount of sugar formed in it.



(7)

P.

Nutrition -

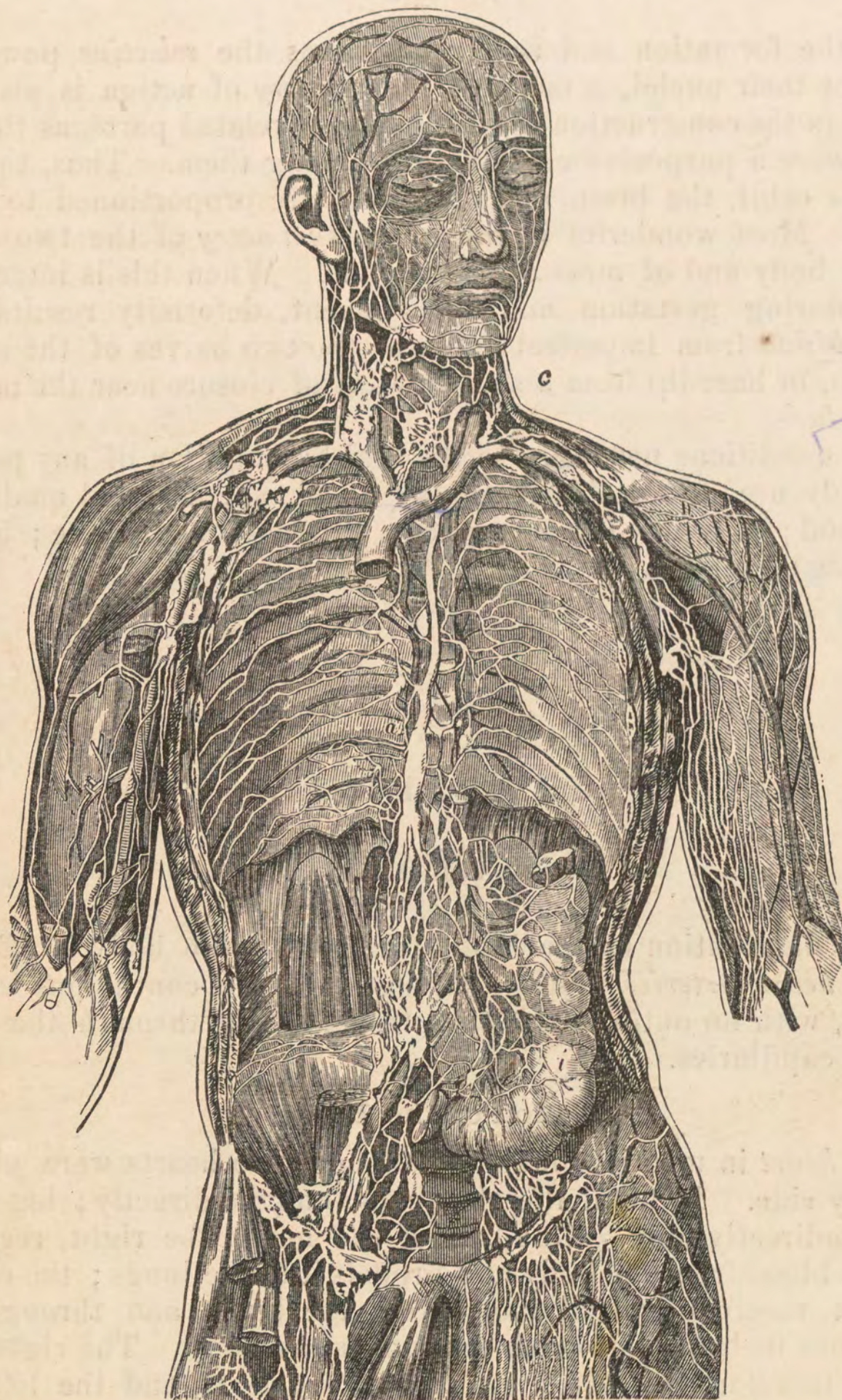


ally inactive. A case has been reported (*Med. Times and Gazette*, Dec. 7, 1867) in which the spleen was removed entirely; yet the woman recovered and seemed to have good health.

Nutrition.

This term may, of course, be attached to *all* that concerns the alimentation of the body. Physiologically, however, it is applied

Fig. 120.



THE LYMPHATICS.—*a.* Receptaculum chyli, commencing thoracic duct. *c.* Descent of the latter to its termination. *v.* Innominate vein.

more especially to the direct appropriation of plasma of the blood to the building up of the tissues. Nutrition, in this sense, comprises four processes: *formation, development, growth, and repair*. The first two of these are predominant in embryonic life. Growth, as well as development, goes on from conception *in utero* to maturity. After that, *repair* is the only result of nutrition; repair of tissue destroyed in active or passive waste, or by disease or injury. Construction and destruction are going on together throughout life.

In the formation and repair of organs, the *selective* power of cells, or their nuclei, is manifest. *Harmony* of action is also observed in the construction of contiguous or related parts, as though there were a purposive combination among them. Thus, the eye and its orbit, the brain and the skull, are proportioned to each other. Most wonderful is the exact *symmetry* of the two sides of the body and of most of the organs. When this is interfered with, during gestation and development, deformity results; as *spina bifida* from imperfect union of the two halves of the spinal column, or hare-lip from a similar want of closure near the middle of the face.

The conditions necessary to the healthy nutrition of any part of the body are, 1, a sufficient supply of blood; 2, good quality of the blood; 3, supply of nerve-force; 4, functional exercise; 5, due intervals of repose.

CHAPTER II.

CIRCULATION.

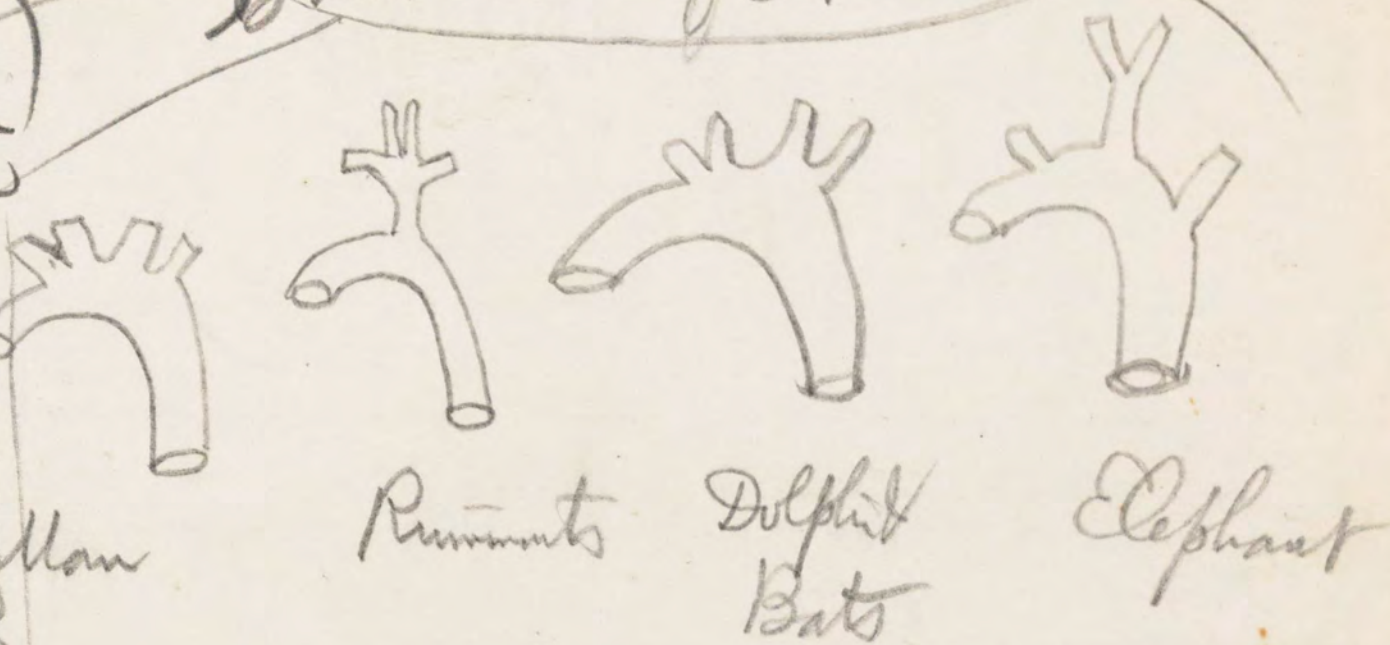
THE distribution of the blood throughout the body is effected by the *heart, arteries, capillaries, and veins*; a continuous closed system, with no outlet, except by transudation through the walls of the capillaries.

Action of the Heart.

The *heart* in man is double, as though two hearts were placed side by side. In foetal life they communicate directly; but after birth indirectly only. One-half of the heart, the right, receives venous blood from the body and propels it to the lungs; the other, the left, receives arterial blood from the lungs, and, through the aorta and its branches, sends it all over the body. The right half might, therefore, be called the *respiratory* heart, and the left the *systemic*.

Circulation in invertebrates: 1st, no vessels nor distinct blood; 2nd channels; (water vascular system) 3^d, appendages, arteries & veins; last, same with heart. (Hemoglobin even in worms) Branches dorsal artery; some articulated & heart; some molluscs a faint (systemic) cav. in B.

one heart of fishes — 3 cav. of Rept. & amphibians
 Birds & mammals
 Branches of Aorta



Aortic Arches

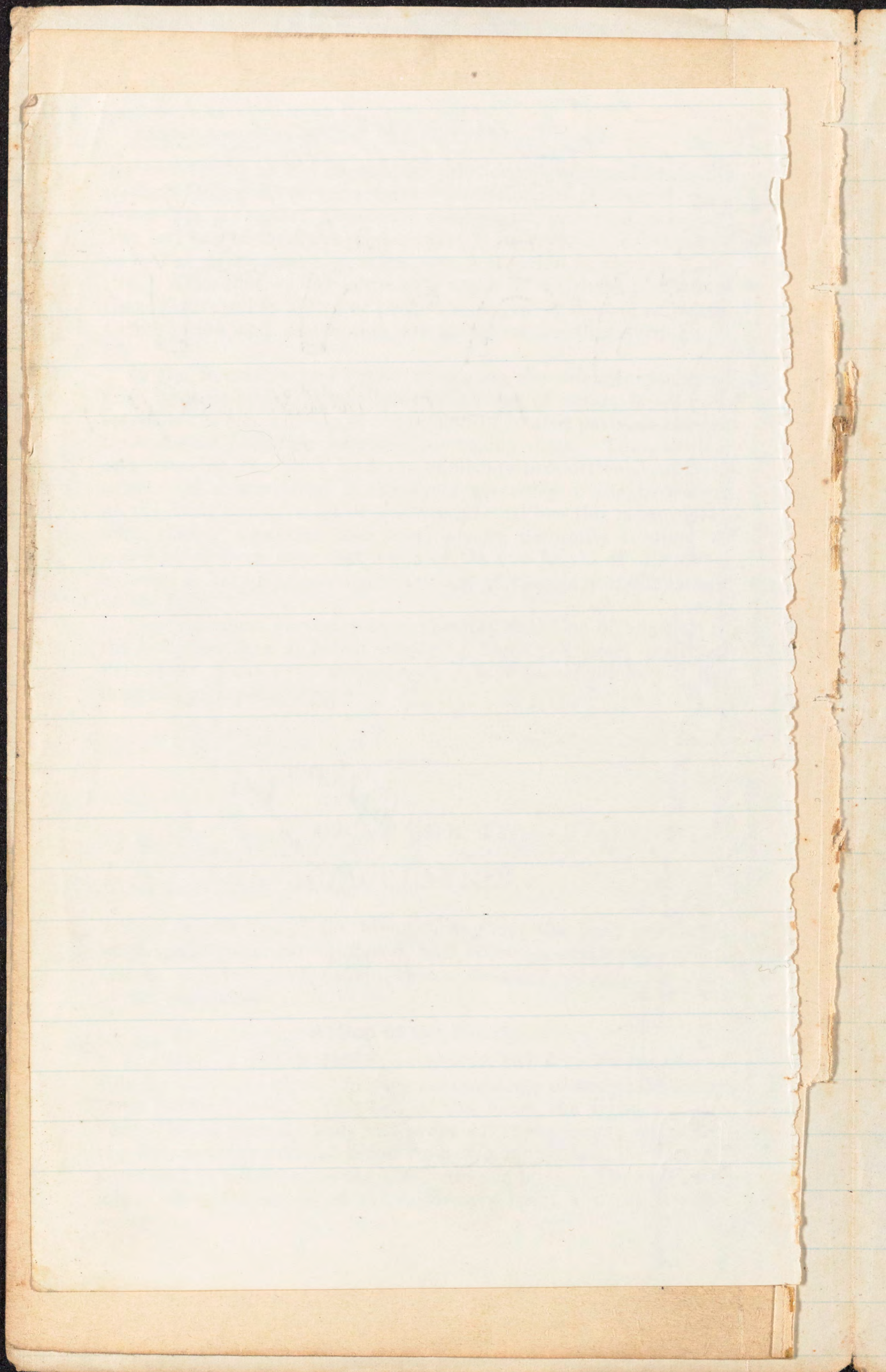
Fishes — 5, going to gills

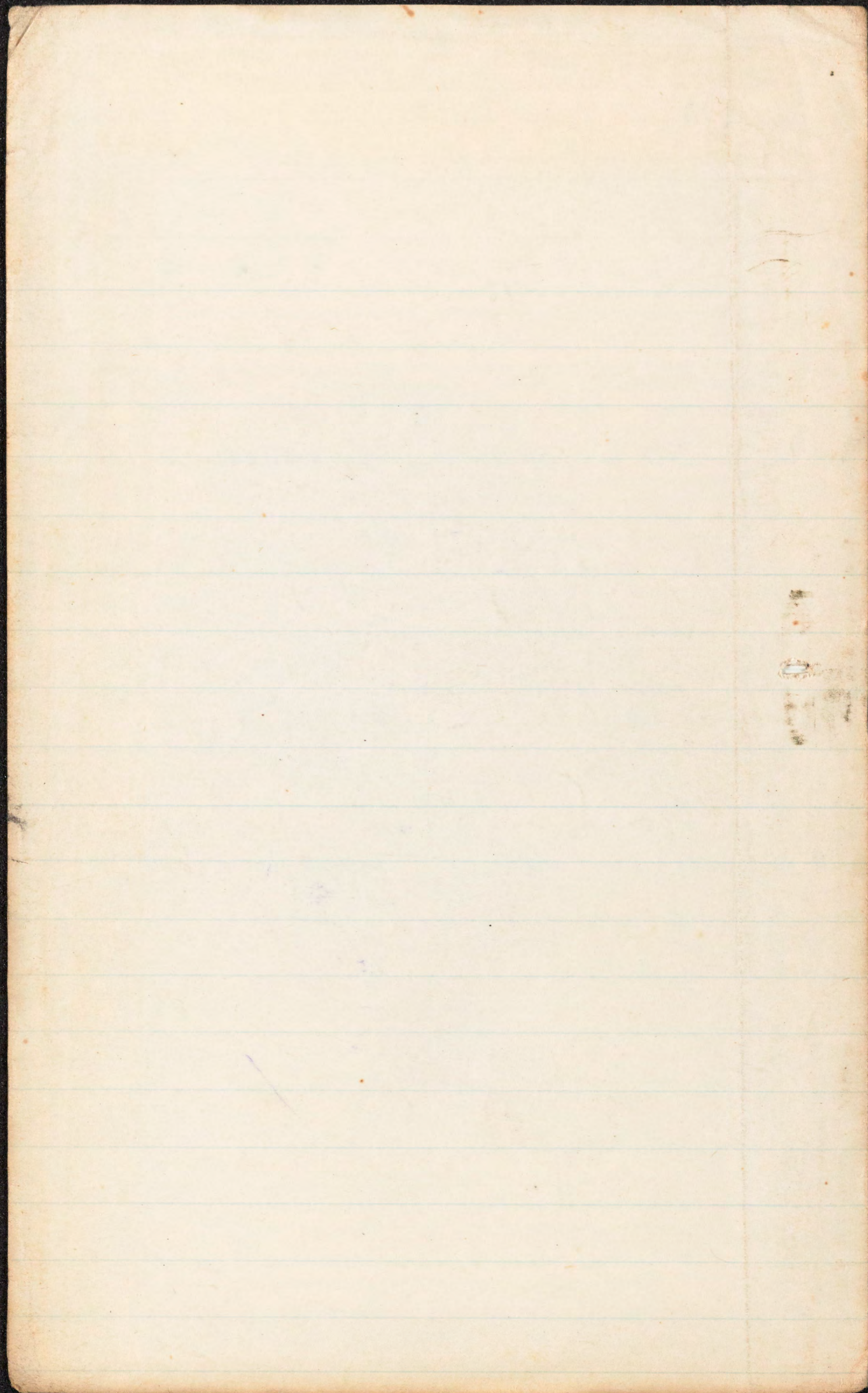
Reptiles: — ^{cephalic, 1} lower 3 ^{higher, 2} _{unites below in abd. aorta}

Birds — 1, over right lung's root

Mammals — like man — 1 over left lung root —

Man — " —







⑧

P.

Circulation

X Confirmed by observations
of Dalton.

Louise's case agrees with this also.

Paget's suggestion that it may depend on the rhythmic or successive character of the nutrition of the different portions of the heart's tissue, - will scarcely suffice. We have to ask, why is the nutrition rhythmic? We would expect it to be always going on at the same rate in all parts of the same organ, except as qualified by comparative activity & Circulation of Blood.

Cavities.—Each of these halves of the heart has two cavities; an auricle and a ventricle. The first is a receiving, and the last a propelling cavity. The right auricle receives venous blood from the venæ cavæ, and pushes it on into the right ventricle. This then propels it, through the pulmonary artery, to the lungs. The left auricle receives blood from the lungs, and transfers it to the left ventricle, which then propels it out by the aorta.

The size of the heart is about that of the closed fist. Anatomists state that it continues to grow later in life than any other organ. Each of the ventricles will hold about three ounces; each of the auricles, rather less. The walls of the ventricles are much thicker than those of the auricles; those of the left being thickest. The force of contraction of the left ventricle is estimated by Valentin at $\frac{1}{50}$ of the weight of the whole body; of the right, half as much. The latter has to send blood only through the lungs; the former, through the whole body.

The tissue of the heart (inclosed in the pericardial sac) is *muscular*; of red muscular fibres, spirally arranged; a sort of double or returning spiral. When it contracts, that is, during the *systole* or contraction of the ventricles, the heart elongates (as shown by Dr. Pennock, of Philadelphia), and is twisted forwards so as to strike the left side below the nipple. This constitutes the *impulse*. The *dilatation* of the cavities of the heart appears to result from elasticity only; it has almost no appreciable suction power.

Valves.—Between each auricle and the corresponding ventricle there is a membranous and muscular valve; the tricuspid valve for the right side, the mitral for the left. (See *Anatomy*.) After the auricle contracts, the contraction of the ventricle follows; and, with this, the muscular columns of the auriculo-ventricular valve close it against the return of the blood. When the ventricles have contracted, the rebound of the arteries pushes out the pocket-like semilunar valves of the aorta and pulmonary artery, so as to close them together.

The *cause* of the heart's action is, probably, the contractility of its muscular tissue, under the stimulation of oxygenated blood. Brown-Séquard's theory of its being due to the action of carbonic acid in the blood is untenable. Rhythmic (*i. e.*, regularly alternating or successive) contraction is the general, indeed the universal law of healthy muscular tissue; as has been proved lately by M. Marey's experiments, even when it seems to be continuous.

Fig. 121.

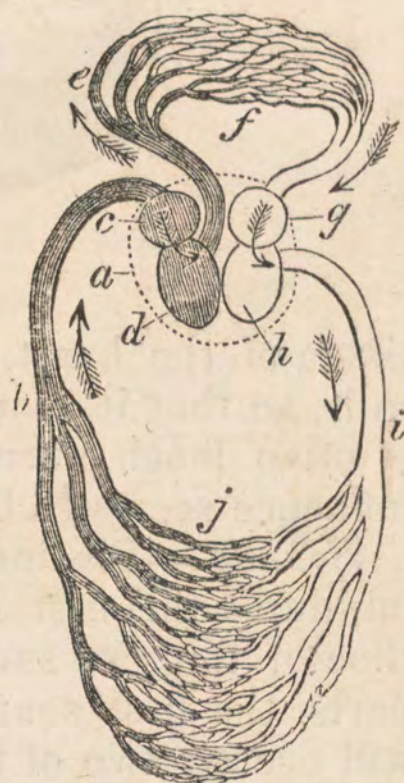
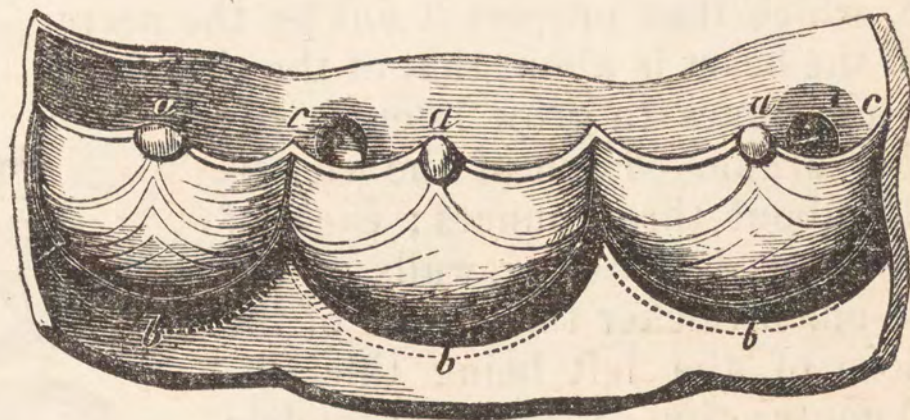


DIAGRAM OF THE CIRCULATION.

The form of the heart and the arrangement of its fibres, are such as to give a *magnitude* to its *alternation* of action and repose, such as is only seen in the body elsewhere in the muscular movements of respiration. Although minute ganglia are discoverable in the

Fig. 122.



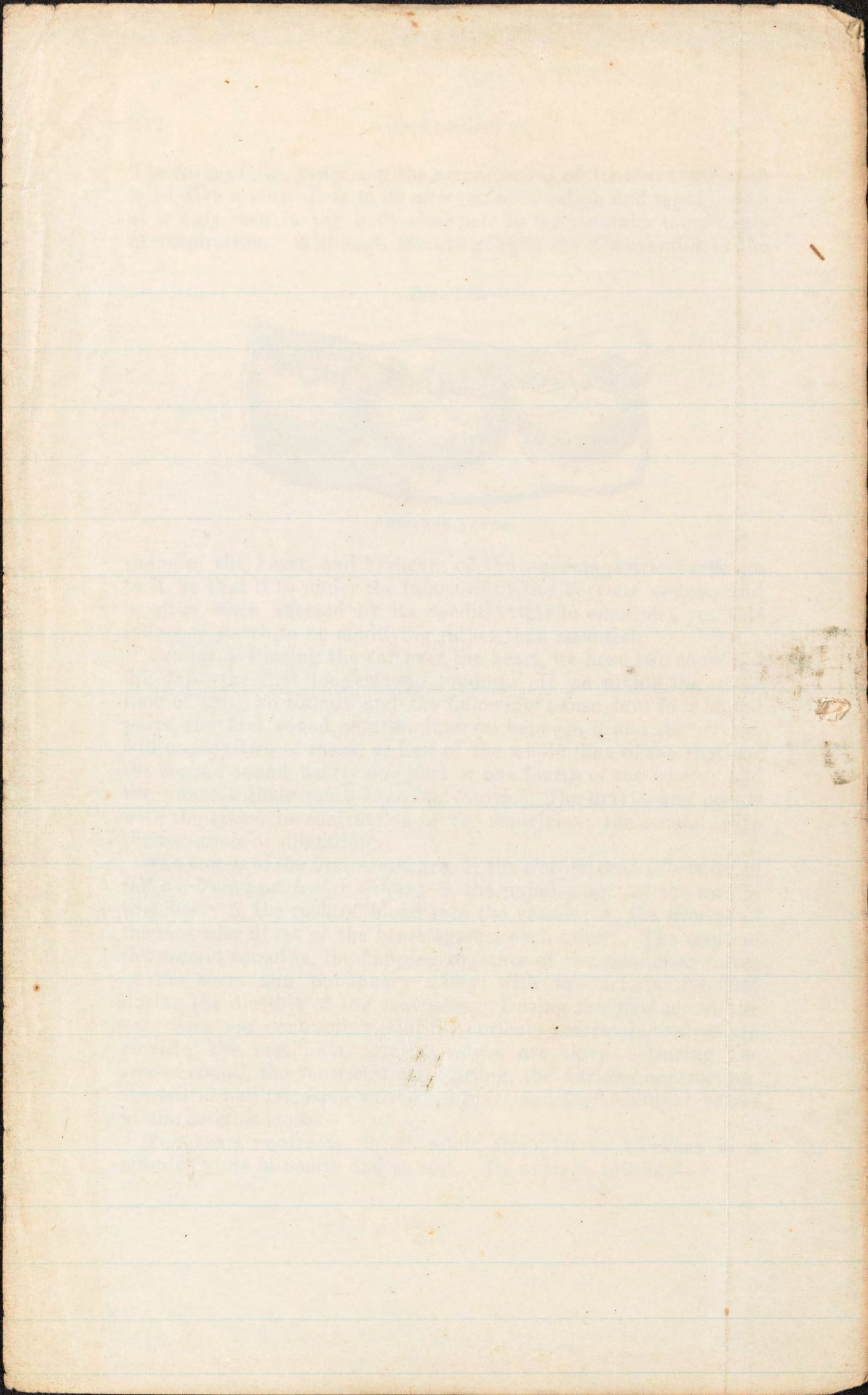
SEMILUNAR VALVES.

tissue of the heart, and branches of the pneumogastric nerve go to it, so that it is under the influence of the nervous system, and is often much affected by its condition (as in emotion), yet this influence seems to be modifying rather than essential.

Sounds.—Placing the ear over the heart, we hear two sounds—lub-dup—the first longest and loudest. If we divide the whole time of the two sounds and the following pause into four equal parts, the first sound, and the interval between it and the second, will occupy two of these, or half of the whole time of the rhythm; the second sound, nearly one part or one-fourth of the whole; and the pause a little more than one-fourth. The first sound occurs with the *systole* or contraction of the ventricles; the second, with their *diastole* or dilatation.

The *causes* of the first sound are, 1, the *closing, with vibration*, of the *auriculo-ventricular valves*; 2, the impulse against the wall of the chest; 3, the rush of blood into the vessels; 4, the friction of the muscular fibres of the heart against each other. The cause of the second sound is, the flapping together of the semilunar valves of the aorta and pulmonary artery, with the arterial rebound during the diastole of the ventricles. During the *first* sound, the ventricles are contracting, and the auriculo-ventricular valves are closed; the semilunar arterial valves are open. During the *second* sound, the ventricles are dilating, the auricles contracting, the mitral and tricuspid valves are open, and the semilunar valves of the arteries closed.

The heart contracts, in an adult, from 70 to 75 times in a minute, while in health and at rest. Its average rate is:—



9

P.

Circulation — Arteries

Cardiograph 2

Physiograph
Manometer

Hemodynamometer &c

PULSE OF VARIOUS ANIMALS. — The pulse of our domestic animals, as given by Vatel, in his Veterinary Pathology, is as follows: horse, from 32 to 38 pulsations per minute; ox or cow, 25 to 42; ass, 48 to 54; sheep, 70 to 79; dog, 90 to 100; cat, 110 to 120; rabbit, 120; guinea pig, 140; duck, 135; hen, 140.

Cardiograph 2

Physiograph
Manometer

Hemodynamometer &c

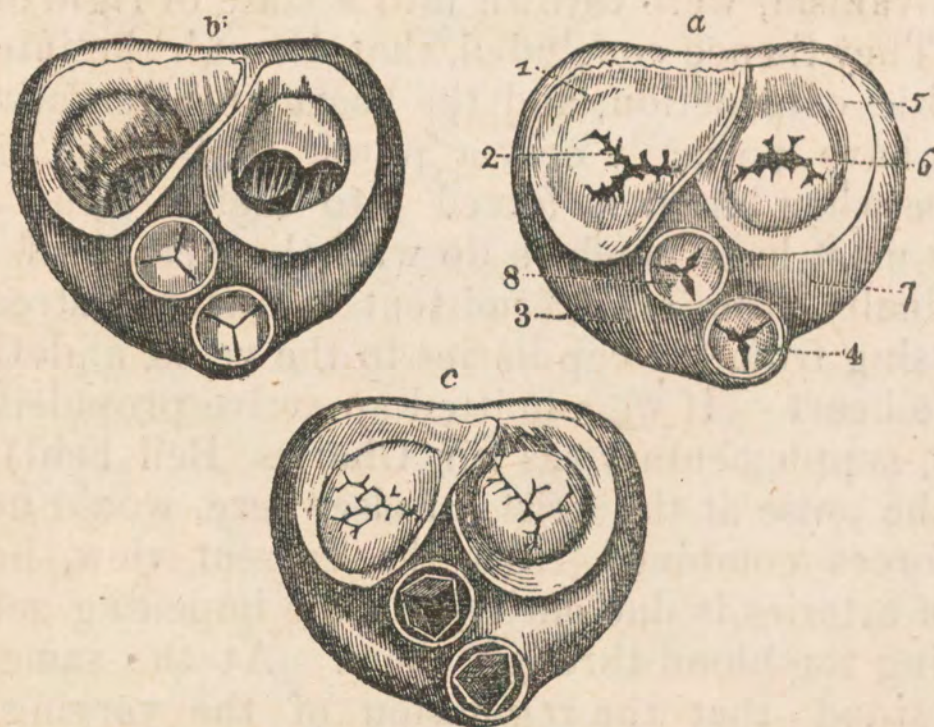
OF SCIENCE

fore the bridges were built, the cattle in treading the streams trod upon the mussels, and the injury done to the shells caused the formation of pearls; but now that the cattle cross by the bridges, the secretion of the pearls is no longer promoted in that way. The peasant could observe the fact, though he could not give the philosophy of it.

At birth, times in a minute	140 to 120
First year " " "	120 " 115
Second year, times in a minute	115 " 100
Third year " " "	100 " 90
Seventh year " " "	90 " 85
Fourteenth year " " "	85 " 80
Middle life " " "	75 " 70
Old age " " "	70 " 50

In very advanced age, however, sometimes it quickens greatly. Dr. Guy found that the pulse was most rapid in the standing

Fig. 123.



VEINS OF THE BASE OF THE HEART.—*a*, 1. Right auricle. 2. Tricuspid valve. 3. Right ventricle. 4. Pulmonary artery. 5. Left auricle. 6. Mitral valve. 7. Left ventricle. 8. Aorta. *b* shows the mitral and bicuspid valves open, and the arterial valves closed. *c* shows the opposite; as during the *systole* of the ventricles.

posture; next sitting, slower lying down. This depends on the muscular effort made in supporting the body. In the female it is a little more rapid than in the male of the same age. In disease it is much more often accelerated than retarded. Great debility is nearly always accompanied by acceleration as well as feebleness of the pulse at the wrist, and of the impulse of the heart. Guy found the pulse somewhat more rapid in the morning than in the evening during health. In disease, it is commonly most rapid in the evening.

Ordinarily, there is a nearly constant relation between the pulse and the frequency of the respiratory movements; there being one pulsation of the heart to three or four respirations.

The Arteries.

All arteries, except the largest, having (unstriped) muscular tissue in their middle coat—the smallest arteries the most—this

See changes on children
Slower breathing
of lungs, quicker pulsations.
under Division of pneumogastric of heart, Dr. Guy

21st Dec 1872

must have some influence upon the flow of the blood through them after the reception of it from the heart. The arteries are found empty after death; as, in their last contraction, they force the blood into the less resistant veins.

The common view among physiologists at the present time is, that the sole office of the muscularity of the arteries is, to *limit*, by *resistance*, the amount of blood passing through them. That is, as Virchow has expressed it, the more healthy and vigorous the action of an artery, the less blood goes through it. This opinion is founded upon some experiments of the Webers; who found that the intestinal canal, heart, and arteries, when powerfully acted upon by galvanism, were thrown into a state of rigid or *tonic* contraction. They thence concluded, that, though the intestinal tube has peristaltic contraction, and the heart an alternating impulse, the arteries have normally only a power to become rigid with a certain force when blood is forced into them.¹ The *elasticity* of the arteries must have much to do with the change of the flow of blood, gradually, from an intermittent to a steady stream, such as we find passing from the capillaries to the veins, and through the latter to the heart. If we admitted an active propulsive power in the arteries, supplementary (as Sir Charles Bell held) to that of the heart, the pulse at the wrist, or elsewhere, would be explained by these forces combined. On the current view, however, the pulsation of arteries is due entirely to the impelling action of the heart, driving the blood through them. At the same time, it is well understood that the regulation of the varying supply of blood to different parts must depend mainly upon the condition of the arteries; as the heart acts impartially towards all, having one trunk only, the aorta, to give out its supplies. In the growth of the deer's horn in the spring, the *rutting* or periodical genital excitement of many animals, the development of the uterus during gestation, and of the mammary gland before and during lactation, there is an unusual flow of blood through those organs. Under other circumstances, as in Bernard's experiment of dividing the sympathetic nerve in the neck, arteries are *dilated* passively, by paralysis of the muscular coat. The flushing of the skin upon a blow or friction, or under the stimulation of mustard, ammonia, etc., seems to show a *reflex* action of the bloodvessels, under nervous influence. Savory asserts the natural state of the

On the fact that the *vaso-motor* nerves, *i. e.*, those which go to the bloodvessels, are all derived from the ganglia of the sympathetic system, certain speculations concerning the action of cold

¹ See *Transactions of the American Medical Association*, 1856, for an argument by the present writer (Prize Essay on the Arterial Circulation) in opposition to this view, and advocating the existence of an *actively propelling* power in the arteries. Also, *American Journal of Medical Sciences*, July, 1868, p. 288.

In 1873, Hick showed, by actual experiments with the manometer, that the pressure in the aorta is greater than in the left ventricle: 80 mm. the latter, 104-128 the former, in a dog.

(See Kiess on Legros Bonimus
peristaltion of arteries: p. 173-4)
Hermann of Zurich, also.

Situation of the arteries
always, place of
greatest security.

Remembrance from arteries
from veins,

Natural arrest of remembrance

Artificial ditto -
Collateral circulation -

(See Galabin or Sphygmograph)

Nature, Aug. 21. 73

He asserts peristaltic action to be too slow,
always, to keep time, in arteries, with the heart's
pulsations. But, peristaltic action in intestines
may have one rate, in arteries another.
Or, even, arterial pulsation may result from
not the next previous heart-beat, but one before that!

!!
vaso-dilator nerves

involuntary muscle
contraction of involuntary muscle
exemplify quick contraction of involuntary muscle
Bladder
urinary

Boulland
experiments & also.

Legros 20 minutes - 1869-72

h 18

in the left ventricle: 80 mm. the latter, 104-128th former, in a dog.

Experiments of Boulland

Prof. Kiess of Strasbourg says (Physiology,
ed. by Duval, trans. by Anon.,
Boston, 1875, p. 169): "we have
found rhythmical contractions still
existing in the heart of an executed
criminal an hour after death."

The manner of death is not here men-
-tioned, which is to be regretted; at
least the total cessation of respiration
for an hour may be presumed to
have occurred.

Human
heart
beating
an
hour
after
death
Kiess

Of these cases four were males and two females. They were aged respectively 20, 35, 38, 53, 46, and 43 years.

The lowest pulse reached in each case was respectively 16, 40, 35, 26, 38, and 24.

In each case recovery took place except the last, who is still under observation. In all the cases in which complete recovery was seen the pulse returned to its normal rate, except in the *second* case, where it remained at 48. It is questionable whether 48 was not the normal rate in that case, but it is altogether probable, however, that the patient would have been cognizant of the peculiarity had such been the fact. That a persistent infrequency of the pulse may be acquired without any impairment of the health, is probably true.

As an acquired normal peculiarity, however, it is rare. Infrequency of the pulse, denoting a variety of functional disorders of the heart, seems to be associated with marked cerebral disturbance.

This was true of all the cases reported, except one.

Napoleon I, habitual pulse 40.

A. Flint Sr. -

NY dtd. Rec. 12/18/75

gard to the utility of competitive examinations; but the opposing element in the shape of men who already hold hospital appointments, or who expect to gain them by influence rather than real merit, is still strong enough to render the immediate adoption of his plan hardly possible. We wish, however, it were otherwise, and still hope for the best.

THE KANGAROO is said to have become acclimated in France, where several landed proprietors have introduced them to their own grounds, where they are hunted like other game. The flesh is now sold in the markets as an article of food, and is considered a great delicacy.

DR. LOMBE ATTHILL has been appointed Master of the Rotunda Lying-in Hospital, in Dublin, *vice* Dr. George Johnson, whose term of office has expired. The other candidate for the position was Dr. Cronyn.

valves, is a fatal objection to this theory. For, if the pulse were the effect of a wave propagated by the alternate dilatation and contraction of successive portions of the arterial tube, it ought, in all the arteries except those nearest to the heart, to follow or coincide with, but could never precede, the second sound of the heart; for the first effect of the elastic recoil of the arteries first dilated is the closure of the aortic valves; and their closure produces the second sound.

The theory which seems to reconcile all the facts of the case, and especially those two which appear most opposed, namely, that the pulse always precedes the second sound of the heart, and yet is later in the arteries far from the heart than in those near it, may be thus stated: It supposes that the blood which is impelled onwards by the left ventricle does not so impart its pressure to that which the arteries already contain, as to dilate the whole arterial system at once; but that it enters the arteries, it displaces and propels that which they before contained, and flows on with what may be called a *head-wave*, like that which is formed when a rapid stream of water overtakes another moving more slowly. The slower stream offers resistance to the more rapid one, till their velocities are equalized; and because of such resistance, some of the force of the more rapid stream of blood just expelled from the ventricle, is diverted laterally, and with the rising of the wave the arteries nearest the heart are dilated and elongated. They do not at once recoil, but continue to be distended so long as blood is entering them from the ventricle. The wave at the head of the more rapid stream of blood runs on, propelled and maintained in its velocity by the continuous contraction of the ventricle; and it thus dilates in succession every portion of the arterial system, and produces the pulse in all. At length, the whole arterial system (wherein a pulse can be felt) is dilated; and at this time, when the wave we have supposed has reached all the smaller arteries, the entire system may be said to be simultaneously dilated; then it begins to contract, and the contractions of its several parts ensue in the same succession as the dilatations, commencing at the heart. The contraction of the first portion produces the closure of the valves and the second sound of the heart; and both it and the progressive contractions of all the more distant parts maintain, as already said, that pressure on the blood during the inaction of the ventricle, by which the stream of the arterial blood is sustained between the jets, and is finally equalized by the time it reaches the capillaries.

It may seem an objection to this theory, that it would probably require a larger quantity of blood to dilate all the ar-

?
no
not
in
radial

Do not reverse this.

teries than can be discharged by the ventricle at each contraction. But the quantity necessary for such a purpose is less than might be supposed. Injections of the arteries prove that, including all down to those of about one-eighth of a line in diameter, they do not contain on an average more than one and a half pints of fluid, even when distended. There can be no doubt, therefore, that the three or four ounces which the ventricle is supposed to discharge at each contraction, being added to that which already fills the arteries, would be sufficient to distend them all.

A distinction must be carefully made between the passage of the *wave* along the arteries, and the velocity of the *stream* (p. 131) of blood. Both wave and current are present; but the rates at which they travel are very different, that of the wave being twenty or thirty times as great as that of the current.

Returning now to the consideration of the pulse-tracings (p. 126), it may be remarked that, in each, the up-stroke corresponds with the period during which the ventricle is contracting; the down-stroke, with the interval between its contractions, or in other words with the recoil, after distension, of the elastic arteries. In the large arteries, when at least there is much loss of *tone*, the up-stroke is double, the almost instantaneous propagation of the force of contraction of the left ventricle along the column of blood in the arteries, or the percussion impulse, as it is termed by Dr. Sanderson, being sufficiently strong to jerk up the lever for an instant, while the *wave* of blood, rather more slowly propagated from the ventricle, catches it, so to speak, as it begins to fall, and again slightly raises it.

In the radial artery tracings, on the other hand, we see that the up-stroke is single. In this case the percussion-impulse is not sufficiently strong to jerk up the lever and produce an effect distinct from that of the systolic *wave* which immediately follows it, and which continues and completes the distension. In cases of feeble arterial tension, however, the percussion-impulse may be traced by the sphygmograph, not only in the carotid pulse, but to a less extent in the radial also (as in Fig. 46).

In looking now at the down-stroke (Fig. 44) in the tracings, we see that in the case of an artery with deficient *tone*, it is interrupted by a well-marked notch, or in other words, that the descent is interrupted by a slight uprising. There are indications also of slighter irregularities or vibrations during the fall of the lever; while these are alone to be seen in the pulse of health, or in other words, when the walls of the artery are of good *tone* (Fig. 45). In some cases of disease the reascent is

exercise in ill-prepared persons; a brisk run, a stiff pull up a hill, will often run the cardiac pulsations up to what might well be considered a dangerous degree, and I have thus seen in my own case, during a severe ascent in Switzerland, undertaken under unfavourable conditions, the pulse beat at the rate of nearly 200.

In addition to these arguments in favour of the view that exhaustion of a certain nerve-force may cause well-marked symptoms by enabling a distinct but usually subordinate function to come into play, we may appeal to the results of treatment. The successful issue of most of the cases I have mentioned was in all probability due to the administration of tonic and supporting drugs, among which digitalis always held a high place. We all know the property which this valuable medicine has in regulating and supporting cardiac contraction by its primary action on the inhibitory centres, as well as its secondary effect on the muscular structures of the heart itself. But, in this connection, my case affords a notable contrast to the others; for it was whilst the patient had been under the full influence of digitalis for twenty-five days that the violent palpitation came on. The remedy was here prescribed under the old-fashioned idea of reducing the labouring action of an enlarged and hypertrophied heart, and before modern research had shown that its use in such a case was not only unnecessary, but possibly injurious. The first result of its employment was to reduce the frequency of the pulse, and its second I fully believe to have been paralysis of the terminal cardiac filaments of the vagi, from that exhaustion which usually follows undue stimulation, and hence the remarkably rapid rate to which the sympathetic urged on the muscular contractions; and this is quite borne out by what is observed on experiment; for Nothnagel lays down the primary action of digitalis to be that of retarding the pulse, whilst larger and longer continued doses inevitably bring about a secondary stage of excitement and great rapidity. In Fox, therefore, it is probable that some temporary disorder of the secretions may have interfered with the due elimination of the drug, and so permitted that saturation of the system which is generally spoken of as indicating a so-called correlative effect. But it may be reasonably asked, Could not an exciting or stimulating influence directed towards the sympathetic nerve-supply of the heart explain more directly the phenomena of rapid pulse? This may be so, and Dr. Richardson was inclined to adopt such a view in Dr. Willett's case, where he believed the sudden emotional shock to have been the factor in enabling the accelerating action temporarily to overcome the controlling power of the vagi. The only other point specially deserving of notice in my case was the observation that, during the rapid action of the heart, no trace of morbid *bruits* could be detected; and this was, no doubt, due to the feeble contraction of the cardiac muscular tissue not emptying the ventricle sufficiently fully or forcibly to bring about the physical conditions necessary for the production of murmur. And it was interesting, at the same time, to hear the clearness and distinctness of the first sound when unmasked by systolic *bruit*.

Remarkable Retardation of Pulse.

Mr. PUGIN THORNTON presented at a late meeting of the Clinical Society of London (*Med. Times and Gaz.*, March 20, 1875) a case in which the pulse had at one time made only 16 beats in the minute, and which for some weeks did not reach higher than 24 per minute. He showed a sphygmographic tracing of it when at 20 beats. The patient was a young married woman, upon whom, in 1872, Mr. Thornton had performed tracheotomy for syphilitic laryngitis. Her pulse at the time of the operation was making 40 pulsations, and it was not until six weeks later, when she was re-admitted into the hospital for diseases of the throat, in order to have the tracheotomy-tube removed, that the extraordinary unfrequency of her pulse was noticed. This unfrequency had been accompanied by transient attacks of an epileptiform character. It appeared that in the summer of 1870 she was first seized with these fits, which at that time happened daily for about two months, the pulse averaging about 24 pulsations per minute. At the end of the two months she completely

recovered, and remained in good health until the autumn of 1872. Mr. Thornton read an account of these attacks, which had been kindly sent to him by Dr. Ransom, of Nottingham, under whose care she had been in 1870. According to his account, a severe fit began with a sudden pallor of face, and complete loss of consciousness and motor power, the heart's action ceasing for several seconds (on one occasion, cessation of the heart's action was noted by stethoscope and watch for eighteen seconds). The respirations then became quickened and almost stertorous; the face flushed, and the eyes suffused, fixed, and turned upwards. She foamed at the mouth. After a time consciousness returned; the expression became calm, no signs of distress remained, and the intellect became clear. After recovery, the pulse returned to its normal rate of 24 beats per minute. During the latter part of the illness she had hallucinations, which, after the fits were over, she clearly recognized as having been spectral illusions. The intensity of the fits was variable; they were sometimes so frequent that she had twelve in a quarter of an hour, and so transient that she was able on recovery to take up the thread of conversation. On one occasion, forty-five were counted in one hour. They occurred equally when she was in or out of bed, asleep or awake. Mr. Thornton remarked that the woman at the present time was in good health, her pulse being constant at 48. She was still periodically obliged to take iodide of potassium to stop the recurrence of the laryngitis, which occasionally threatened. He was at a loss to account for the curious phenomena, unless that the pneumogastric nerve might be presumed to be in some way affected by the specific poison. Unfortunately, the time of the syphilitic infection was in no way clear, for Dr. Goddard, of Pentonville, and Dr. Ransom had no recollection of her suffering from any of the usual sequelæ of syphilis. In his own mind there was no doubt that the unfrequency of the pulse was to be attributed to it. The instrument by which the tracings had been taken was one manufactured by Mayer and Meltzer. A pressure of 350 grammes was used in each observation.

Mr. CALLENDER asked if in the earlier observations any notice had been taken of the frequency of the pulse. Was the unfrequency only recent, or had it occurred early in life? There were cases of extreme slowness of pulse associated with some injuries to the head; in such a case one always tried to ascertain the frequency of the pulse before the accident. In some cases of slowness of circulation, the patient seemed to suffer greatly from cold; but a patient of Mr. Callender's recently (St. Bartholomew's) had a pulse of 32 only, whilst a more robust man there could not be.

A member mentioned that in one of the earlier volumes of the *Medico-Chirurgical Transactions*, there was a case recorded in which the pulse ranged from 25 to 27. After death it was found that the foramen magnum was so contracted that it would hardly admit the tip of the little finger; and there was hypertrophy of the superior cervical ganglion of the sympathetic nerve.

Dr. SYMES THOMPSON remarked that the late Mr. Hodgson had a pulse which rarely exceeded 32; he was wont to draw especial attention to the fact that a slow pulse might exist for years without the production of any manifest symptom. He combated the notion that it meant a fatty heart. When the action was slow, any great exertion was apt to be exhausting, and exposure to cold was very hurtful.

Dr. SOUTHEY would like to ask whether Mr. Thornton had noticed that micturition was very frequent or the quantity of urine very large. When digitalis was used, the action of the heart being very slow, the quantity of urine was often very large, the pressure on the renal capillaries being great. A man, aged eighty, whose pulse had always been slow—usually from 18 to 20, and rarely reached 26 after exertion—had noticed the slowness for many years. Were fits associated with slow pulse? In this case the epileptic convulsions would seem to be associated with diminished supply of blood to the brain.

Mr. MAHOMED had taken sphygmographic tracings of a very slow pulse in a woman. The systole was not prolonged, but the diastole was much prolonged. Her pulse had been 65 before she was shut up in Paris during the siege, to which she attributed the change. Weakness, tendency to fainting fits, and the

slow pulse had since ensued; the fainting being, perhaps, due to emptiness of the vessels of the brain.

Dr. ARCHIBALD HEWAN mentioned his own case. Twenty years before, he had studied greatly; his pulse then was 72 in the minute. Afterwards it was found to be 55; from that point it had gradually decreased; eight years ago it was 24. Then Dr. B. Sanderson traced it with the sphygmograph. He had been abroad, never had a fit nor fainted, and could bear cold well. He had lately climbed a mountain many thousand feet high, and his pulse at the top was 40. His urine had not altered in any way; his digestion was very good, and he was in good health.

Dr. ALTHAUS said that the Emperor Napoleon the First had a slow pulse, and always felt uncomfortable, except in the excitement of battle, when it would rise to 60 in the minute.

Mr. THORNTON stated that the pulse of his patient had not before her illness been noticed to be very slow. At the time of the operation it was 40; a few weeks afterwards it was 16. There was no valvular disease in this case. He had never heard that the urine was very copious, and would judge it was not so.

Dr. A. HEWAN mentioned that he had had rheumatic fever eight years ago, when his pulse did not rise above 32. Eight weeks ago he had gout and rheumatic pains, when his pulse quickly rose to 64 and 68; and then fell slowly to 32 and 28, at which it stood at present.

A case recently brought before the Société de Biologie of Paris, by M. CORNIL (*Lancet*, June 26, 1875), affords another illustration of the phenomenon of slow pulse, which it will be remembered formed recently the subject of an interesting discussion at the Clinical Society in connection with the case related above by Mr. Pugin Thornton. The exact length of time during which M. Cornil's patient presented the slow rate of pulse is not stated in the report from which we quote (*Progrès Méd.*, June 5th), so that in some respects it cannot well be compared with the cases related at the Clinical Society. The patient was seventy-five years of age, and for four years had suffered from cough in the winter, when he was also subject to attacks of vomiting. When first seen the pulse rate was from 25 to 30 beats per minute; but on May 23d it was only 14, but perfectly regular. Respiration was unembarrassed. About every quarter of an hour there was oppressed and suspicious breathing, these attacks ending in syncope, with pallor of face, closure of lips, and convulsive movements of the arm. Each attack was preceded immediately by an intermission of the pulse, lasting some seconds. The attacks continued till death. There was found extreme and universal fatty degeneration of the heart, which was normal in size. There were also pulmonary emphysema and fatty degeneration of the pancreas.

Hyperidrosis excited by change of Posture.

Dr. DAVID INGLIS, of Detroit, Michigan, reports (*Detroit Review of Med. and Pharm.*, August, 1875) the following very curious case.

Mrs. F., æt. 45, strongly built, generally healthy, mother of four children, youngest æt. about 8 years, gives the following history:—

Some five years ago, her health, which had previously been good, began to suffer. She had leucorrhœa, and other symptoms of uterine trouble. She was also much afflicted with pains in all parts of her body, which, from her description, seem to have been of the nature of subacute rheumatism.

After passing through the hands of various physicians, she came at last to a travelling "root doctor," who left her a large quantity of his wares, to be taken in large doses. Hereupon her pains left her, but a trouble began which continued unabated up to the time when I saw her—some six weeks since—namely, profuse perspiration, brought on nightly by lying upon her right side. This phenomenon occurs regularly every morning after a night's rest in bed, and only then, her usual habit being to turn over on to her right side, and at once a general perspiration begins, which at once ceases upon her turning back on to her left side. She can lie upon her right side during the day, or early part of the night, without perspiring. If she does not turn upon her right

side, and so secure a sweating in the morning, she feels much oppressed during the day, has a headache, and is poorly until she again has a sweat the next morning.

If, owing to other causes, the sweating is stopped, she feels the same oppression and headache, and it was upon such an occasion that I was first called to see her. Upon giving some sudorific she was soon relieved.

Further, she is in summer, during warm weather, very prone to perspire, and has every summer much annoyance from a very abundant crop of sudamina, which causes an almost intolerable itching. The sweating in winter is not accompanied with sudamina, and the perspiration has at no time any peculiar odor.

In looking over the literature of hyperidrosis, I can find no report of a similar case, although various anomalies of perspiration are mentioned. Cases are reported of very profuse perspiration coming on after eating. Another of perspirations so profuse that basins had to be placed beneath the patient to collect the moisture.

Cases of unilateral perspiration and of perspiration confined to limited portions of the skin are mentioned, but I can find no notice of a case where the sweating was general, but brought on at will by a change of posture. In regard to the pathology of these affections much remains to be learned. Anything which causes a hyperæmia of the capillaries which supply the sweat glands, seems to cause sweating. Such is the direct action of heat, of muscular exertion, and, indirectly, such hyperæmia and consequent sweating are caused by anything which relaxes the vaso-motor nerves of the part.

In this way are to be explained the action of various emotions in causing sweating. Similarly section of the sympathetic in the neck causes profuse perspiration in the parts above. Drugs, or any artificial means of causing sweating, if used to excess, have a tendency to hyperidrosis. In this case the large quantities of drugs taken five years or so ago, probably caused a relaxed state of the skin capillaries, and probably the repetition of the sweating is due to a relaxation of the vaso-motor nerves of the skin; but I find no theory to account for the relation of posture to the relaxation of the vaso-motor nerves, and therefore submit the case, hoping that some one may be able to find such a relation.

Three Cases of Dilatation of Lymphatic Radicles.

Mr. C. HANDFIELD JONES reports (*Lancet*, July 31, 1875) three cases of this.

CASE 1.—W. S——, aged nineteen, fetler, admitted on January 11, 1875. Family history good; father, mother, brothers, and sisters alive and well. No history of previous illnesses. About six weeks ago he had slight catarrh and cough, and noticed a small swelling of his neck. This was soon followed by swelling of the left side of the face and of the upper part of the head and forehead. It then appeared in his hands, and afterwards in his feet and legs. He had at the same time pains in the loins, which were not much felt unless he moved about. His urine at the same time was brown and thick and very scanty, and was passed very seldom. His appetite has never failed; his bowels have been pretty regular. He does not think he has lost flesh. Is anæmic-looking, but skin of trunk and abdomen is markedly brown, except a small patch near left iliac crest, which is white, the demarcation being abrupt between the pale and brown parts. Heart sounds are healthy. No anasarca, but the abdomen is markedly dull for some extent in both flanks, in the left especially; the dullness in left is diminished when he turns on right side. Urine: sp. gr. 1030, deposits red lithates, is highly albuminous. Has simple diet—milk, beef-tea; ordered chop; and, in place of fifteen minims of ipecacuanha wine, and one ounce of citrate of potash mixture, four times a day, which he has had for two days, he is now to have solution of perchloride of iron, fifteen minims, and acetate of ammonia mixture, one ounce, three times a day, taking one drachm of compound jalap powder every morning.

Jan. 18. Legs more anasarcous, feet pit markedly; both fundi very pale, discs not well-defined; sight is good; he can read a paper.

ON THE
PRESENT CONDITION
OF
VASO-MOTOR PHYSIOLOGY.

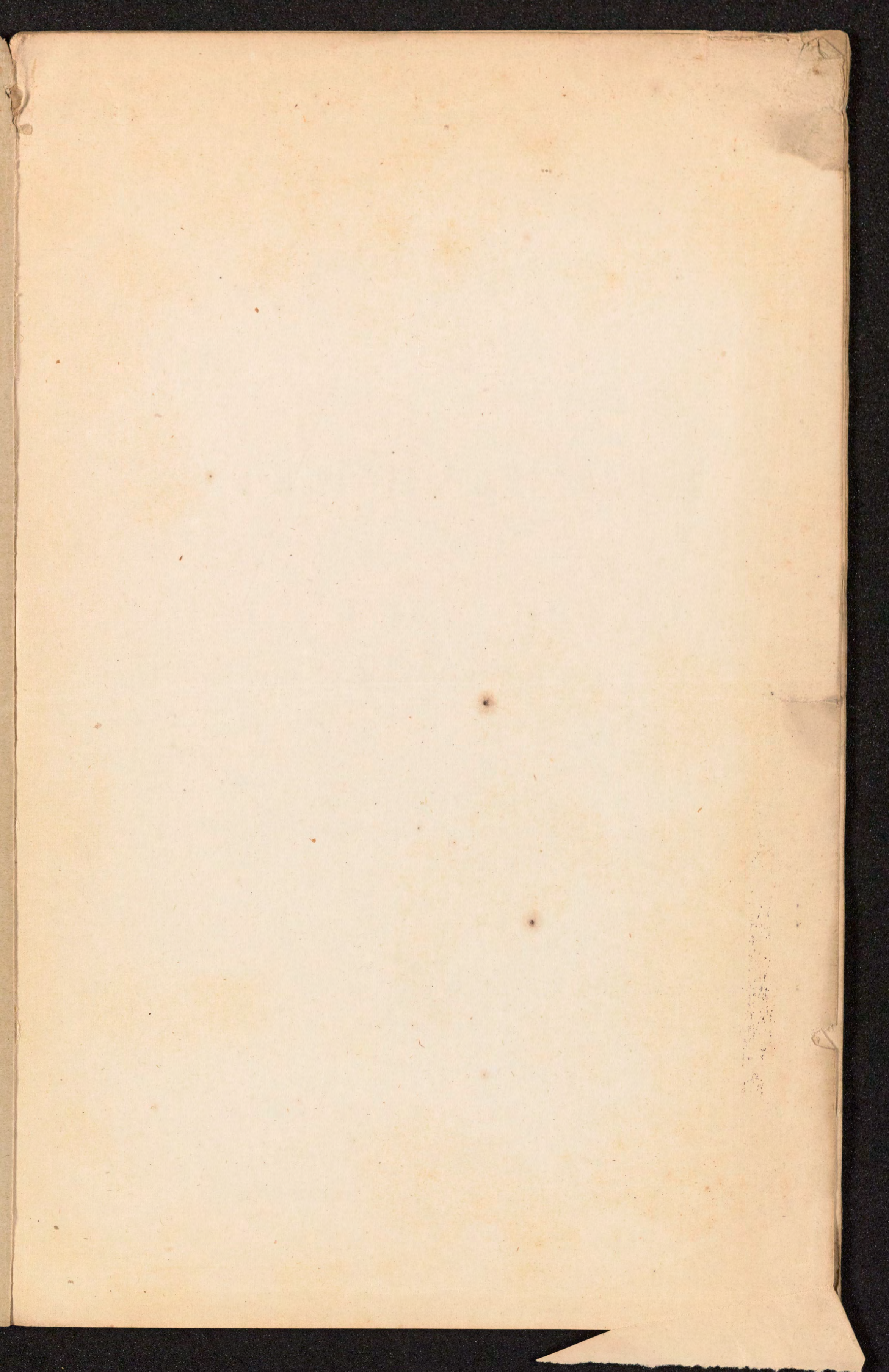
BY
HENRY HARTSHORNE, M.D.

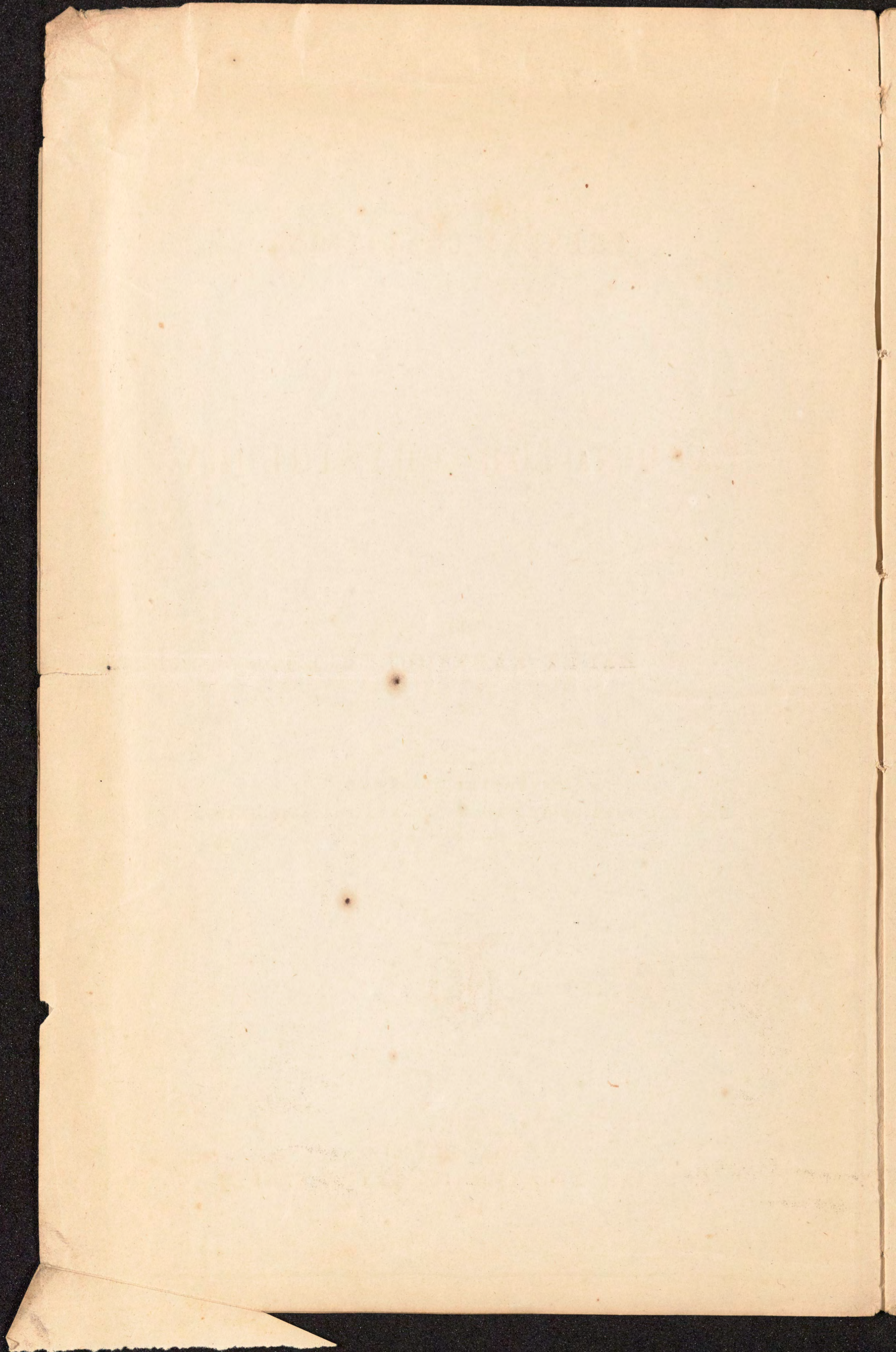
EXTRACTED FROM THE
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PHILADELPHIA:
COLLINS, PRINTER, 705 JAYNE STREET.
1872.

THE UNIVERSITY OF CHICAGO





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Prof. Hermann,

of Zürich, teaches

Actinopterygii

1875.



ON THE

PRESENT CONDITION OF VASO-MOTOR PHYSIOLOGY.

IN the *Transactions* of the American Medical Association for 1856, the privilege was accorded to the writer of publishing a paper upon the Arterial Circulation, in which views were expressed and maintained, somewhat at length, in partial opposition to the then prevailing opinions of physiologists. It was at that time the teaching especially of the Webers, Virchow, and Bernard (to whose names have been since added amongst others those of Huxley and Marey), that the whole and sole functional action of the smooth muscular tissue, so abundant in the smaller arteries, is to limit, by its contraction, the flow of blood through the vessels; called by Prof. Huxley a "flood-gate" and by others a stopcock function; so that, as Virchow has expressed it, "the more active the vessel, the less the supply of blood." Opposed to this view have been the opinions of some of the older writers, as Unzer, Prochaska, John Hunter, and Sir Charles Bell; and against it, moreover, as it has appeared to the writer, is an overwhelmingly strong presumption, from the positive evidence of general physiological analogy.

Slow as has been the progress of recent investigation upon this point, Prof. Lister, of Glasgow, made an important impression upon the general tendency of reasoning concerning it, in 1858; in a direction in part quite similar to that of the Essay already referred to, of 1856. Since 1868, however, a more decisive contribution has been made to the inquiry, by the elaborate experimental researches of Legros and Onimus; published in the *Journal de l'Anatomie et de la Physiologie*, 1868-70. Some, at least, of the writers, before inclined to deny that any ground existed for doubting accepted views on the subject, now admit that a revision of those views becomes necessary; and it appears to be hardly too soon to anticipate that, very shortly, a reversal of the common teaching of the last twenty-five years concerning arterial physiology will have to

be made in all the books. Holding this opinion, I have thought it *à propos*, as a member of this Association, to lay claim, on behalf of its *Transactions*, for a certain part in the progress of this important inquiry, in the publication of the paper referred to, partially indorsed at the time by the award of the prize of the Association; in which, facts, reasonings, and conclusions were collated, in advance of all written upon the subject since the "Essay upon the Circulation" of Sir Charles Bell. I propose, in the paper now presented, to state, briefly and succinctly, the most essential links of the chain of argument by which, as it appears to me, a true conclusion upon the mode of action of the arteries may now be reached and sustained. A certain portion of this summary will be recapitulatory; as the time elapsing since my first publication is so considerable, and a later paper¹ had a somewhat disadvantageous opportunity of presentation to the profession. But the recent establishment of some facts which appear to be of demonstrative force, has been the occasion of my requesting renewed attention to the question at this time.

At the foundation of all study of the subject lies the universality of the law of *alternating* contraction in muscular fibre; first clearly shown by Bowman, many years ago, but more amply and elaborately established, within a few years, by Marey. Even in the most seemingly rigid tonic contraction, the latter experimenter was able to prove that it was not absolutely fixed, but rapidly vibratory, in every filament. All authorities agree, moreover, in finding this rhythmic character to prevail most evidently in the smooth or non-striated muscle of organic life; the heart, however, among the striated muscles, affording its most typical instance. In the veins, rhythmic contraction has been noticed by Wallæus, Steno, Lower, Whytt, Haller, Lancisi, Senac, Broussais, Allison, Marshall Hall, Flourens, and Wharton Jones, under various circumstances. In the pancreatic duct and ductus choledochus, such alternating contractions have been observed by Bernard, and by Brown-Séquard in the trachea and bronchia of birds. We are warranted by these as well as by the more familiar example of intestinal peristalsis, in conceiving it to be a most strong presumption, that everywhere, even in the arterial system, the law of smooth muscular tissue must be, that *its normal action will be alternating or rhythmic*, its abnormal condition only, that of temporary tonic contraction or rigidity.

¹ American Journal of ~~Natural~~ Sciences, July, 1868, p. 290; under "American Intelligence," etc.

Medical

Certain facts in animals seem to make necessary this explanation. In fishes, for example, the heart is respiratory; its impulse being to a large extent expended in sending the blood through the gills; this must then find its way through the system mainly by arterial action. *Amphioxus* presents a sort of demonstration of this; as this fish has, instead of a true heart, a number of pulsatile dilatations of the great arterial and venous trunks; parallel to the enlargements, with similar function, in insects, myriapoda, and some other articulates. Allen Thomson remarks upon the difficulty of understanding how arterialized blood is distributed, in the whale, from the net-works of arteries connected with the intercostal and other vessels. This difficulty disappears when we perceive, in these arteries, a normally propulsive power.

Acephalous foetuses afford evidence of an analogous kind. St Hilaire, Chaussier, and Adelon aver that every acephalous foetus is *acardiac*, as well as having no lungs. The circulation *must then be carried on by the arteries*. Every human embryo is, for a certain time, as *acardiac* as that of a myriapod; so that in it, also, the circulation must be arterial and capillary only, so far as its propelling power is concerned.

Erectile tissues present a problem only thus to be solved. Long ago, Müller discovered the *arteriæ helicinæ* of the penis; confirmed by Valentin and Kölliker. Earlier still Prochaska proposed the explanation that erection is caused by *active arterial injection*. The idea that a dilatation of the venous trabeculæ of the corpora cavernosa is an active cause of erection, is at once disproved by the absence of any such trabeculæ from the nipples, which also are truly erectile; and whose erectility, therefore, must be an active arterial phenomenon.

Legros, in 1868, having proved the remarkable thickness and power of the muscular tissue of the arteries of erectile tissues, asserts "*c'est bien l'élément contractile des artères qui agit pour produire l'érection.*"

What can we make of the reddening, from increased vascularity of the skin, when struck with a switch or the hand (even a short time after death), or under the stimulus of friction, mustard, ammonia, or cantharides? Surely there is no "paralysis" of vaso-motor nerves, or of arterial muscular tissue, under any such causation. If there be a pure stimulation anywhere of a reflex or excito-motor character, it is here. Nor, in blushing, have we a right to make the assumption, often made, that a paralytic dilata-

tion of the facial vessels occurs. It, also, is an active arterial determination; a certain weakness of balance and control being thus shown, analogous to (though less morbid than) the muscular contractions in convulsions, in which the brain's control is withdrawn or overborne.

But more unquestionable instances still, perhaps, of arterial activity are seen, in certain states of physiological erethism; as, the flow of blood toward the maxillæ during dentition; to the ovaries during ovulation; and the testicles during spermatic excitement, periodic in many animals; to the uterus in gestation, and the mammæ before and during lactation; at the time of the new formation of the antlers in the deer, etc. In all these cases it seems an entirely gratuitous contradiction to suggest the idea of "paralysis" having any existence whatever.

Let us put together a few more facts now well known. In paralytic limbs the pulse has been often found diminished in force and fulness; the artery being gradually weakened, and thus not passively dilated as it is by the sudden section of the sympathetic nerve. From the arteries of a mortified limb there is no hemorrhage; the propulsive power of the vessels is lost.

When a limb has been crushed by a railroad car, or torn by a gunshot wound, the paralyzed artery does not bleed for the same reason.

Injection through the aorta in an animal just killed passes easily, as I have seen it do, to and through the capillaries: because the arteries assist in carrying it on. A longer time after death the resistance is much greater; the elasticity of the vessels, of course, remaining the same. A similar pointing towards the muscular propulsion of the arteries is very familiar, in the fact that they always empty themselves into the veins after death. In decapitated criminals, moreover, the blood (as Robin has shown) does not, as may have been expected, spout from the divided carotid and vertebral arteries, but goes on in the head carrying bubbles of air after it.

Legros and Onimus found, upon tying the larger vessels in animals, that the circulation was not at once arrested, but continued for a time, longer in cold blood vertebrates than in mammals. This observation had before been made, also, by Wilson Philip, Haller, Spallanzani, Kaltenbrunner, and Marshall Hall. More remarkably, Chauveau observed that compression of an arterial trunk, stopping the blood-current through it at the place of pres-

sure, does not always arrest the pulsation of the vessel, which must, therefore, have an *autonomy* of its own. Legros and Onimus state that in the human retina, in a case in which the *arteria centralis* had been obliterated by a clot, they could distinctly see, through the ophthalmoscope, peristaltic waves in the small vessels of the collateral circulation. Bernard found that after division of the sympathetic on one side, the pressure of the arteries upon that side was lessened; showing that (just the contrary of what has been often stated) the effect of innervation from the sympathetic is to *add to or confer* propulsive power in the vessels. Every one is now quite familiar with the paralytic dilatation caused in the "rabbit's ear" experiment of Bernard; and with the proof of its being paralytic found in the fact, that galvanic stimulation of the distal end of the ganglionic nerve will remove for the time the passive hyperæmia, by producing contraction of the muscular coats of the arteries involved. We have, then, in different cases, a passive, paralytic dilatation, with *slower* movement of blood, as well as an active, propulsive enlargement, with *acceleration* of the blood movement. Both of these are seen, and have often been described, in different parts, or stages, of the process of inflammation. Green, in his work on Pathology and Morbid Anatomy,¹ notices this; but, being under the influence of the view still current, of the purely stopcock action of the arteries, he somewhat *naively* remarks: "How an excitation of the nerve produces dilatation of the vessels and increased rapidity of the circulation is, however, unknown." According to the view now and here taken, it is precisely what was to be expected, as the primary effect of a direct excitation, not sufficient in power to produce the result often witnessed by Wharton Jones and others, of *contraction*, followed also by passive dilatation; this last being the consequence of muscular exhaustion or fatigue and relaxation. Contraction, or rigid tonic action of the muscular tissue of an artery, as in the galvanic experiments of the Webers (which have been long allowed to have undue weight upon this question) we may well now perceive to be a wholly and merely *abnormal, pathological*, and exceptional result.

Professor Lister obtained² the attention of physiologists to the importance of reflex action in the vessels in connection with

¹ Philadelphia edition, p. 180.

² Philos. Transactions, 1858.

inflammation, as well as to the diminution of vitality in a part under "irritation," at the place of central stasis and arrest of nutrition: all of which points were fully set forth and insisted upon in my Essay in the *Transactions* of this Association of 1856.

The definition proposed for inflammation in that Essay was "a local lesion of nutrition, with concentric vascular excitement resulting in exudation." Later, I added¹ the words "or cell-distension and proliferation." In Stricker's account² of the experimentally produced phenomena of inflammation, we find the following: "traumatic interference, disturbance of circulation, exudation of fluid and morphological constituents, disturbances of nutrition, new formation."

We have an illustration of the practical importance of the part taken in the inflammatory process by the action of the vessels (almost ignored by Virchow, Bennett, and others, but restored to the attention of the profession by the remarkable observations of Cohnheim), in the sedative effect of ligation or compression of the artery supplying blood to an inflamed part. On this topic, a valuable paper was contributed by Dr. S. W. Gross;³ setting forth numerous facts of this import observed by himself and by Drs. Onderdonk, Rogers, H. F. Campbell, Maunder, Vanzetti, and Blackman.

This paper would have to be too much extended to enable me to state fully the application of the above conclusions to pathology and practice. One or two points only may be named. The theory of fever may need now to be reviewed; and an idea believed for a time to be obsolete may have to be revived, viz., that during the chill there is spasmodic constriction of the smaller arteries, followed by their relaxation during the hot stage, transudation being then interrupted, but renewed again, with critical increase of secretion when the vessels are recovering their normal calibre.

Dr. George Johnson's theory of the pathology of cholera, so far as it emphasizes the constriction of the pulmonary artery and its branches, seems to fall short by limitation; it ought to have been extended to *all* the arteries, and to the organic muscular tissue everywhere throughout the body. From this must result (as Dr. C. D. Meigs well called it "*the cholera squeeze*") a transudation of blood-serum into the channel most natural for its escape; as well as, also, the general *sthenic spasm* of the collapse itself.

¹ *Essentials of Practical Medicine*, 1867.

² *Experimental Pathology*, Vienna, 1869.

³ *Philada. Med. Times*, Jan. 16, 1871.

Dr. G. Johnson has proposed an ingenious conjecture concerning the hypertrophy of arterial muscular tissue in the kidneys, along with hypertrophy of the heart, in Bright's disease. He believes it to be adaptively protective, by *checking off* (according to the current vaso-motor theory) the entrance of blood when the kidney tissue is so obstructed as not to be prepared to allow the natural secretion to occur through it. Instead of this theory I would suggest, that the hypertrophy *both* of the heart¹ and of the minute ramifications of the renal arteries is most probably protective, in a manner essentially the same as that which is usually accepted as accounting for cardiac hypertrophy in valvular affections; namely, under increased activity needful to overcome the resistance of obstruction; in the heart, direct resistance to the flow of blood; in the kidneys, to normal secretion and transudation.

A single word must conclude what I have to say upon the topic of the pulse. Its factors must clearly be:—

1. The heart's impulse. —
2. The elasticity of the vessels.
3. Closure of the aortic valves.
4. The muscular arterial systole. —

Cardio-systole

Sphygmo-systole

a. H.

Sanrod

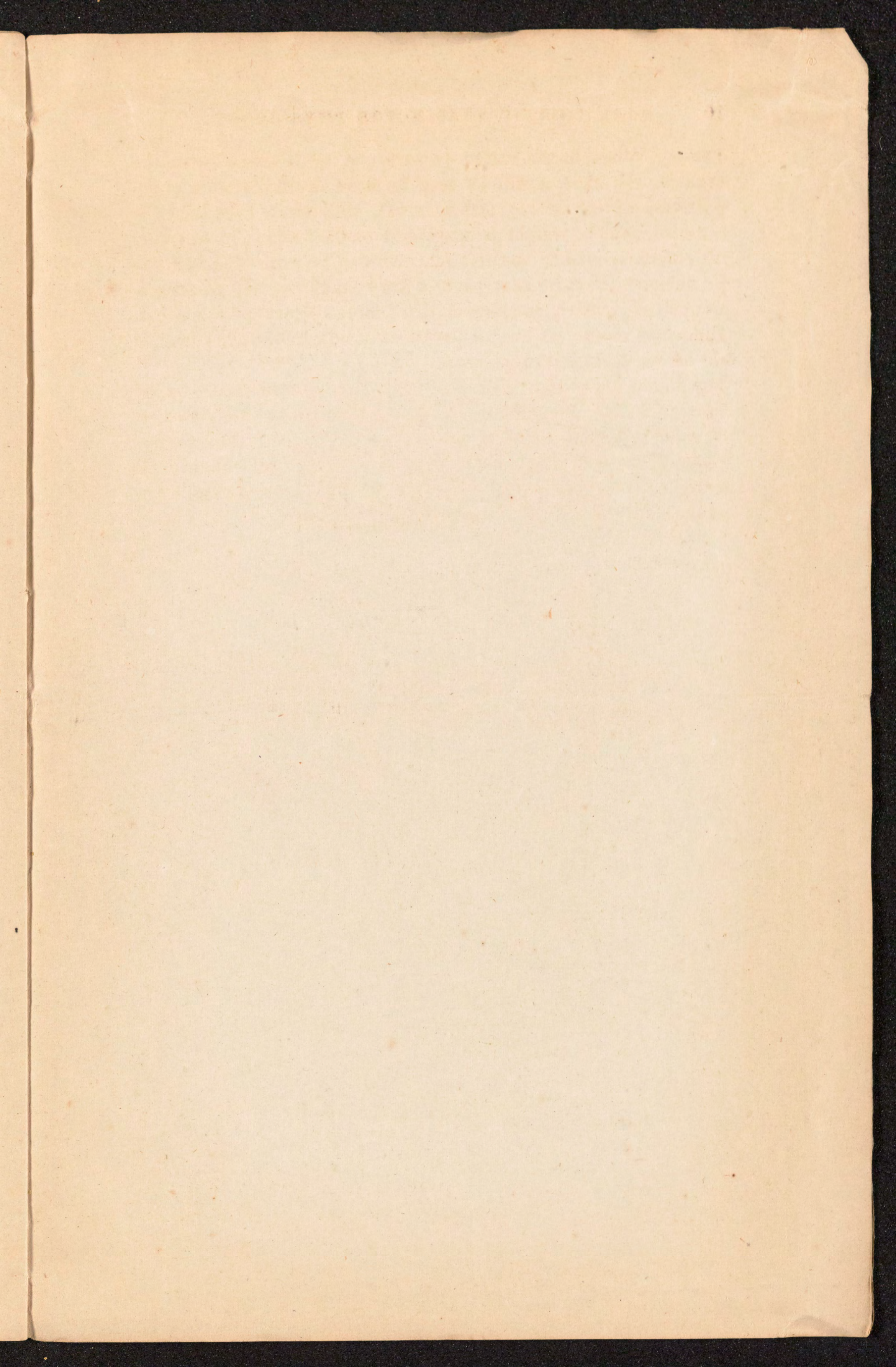
The latter, the muscular element, *cannot* be *null*, because it empties the arteries after death. It cannot maintain the arteries in a constantly fixed state of definite rigidity, or the finger would detect it, in vessels large enough to be felt, which have a considerable share of muscularity. Therefore, since there must be time for the elastic tissue in the larger and medium-sized arteries to *second* the wave-movement produced by the heart's impulse, before the wave of momentary stiffening and contraction in the smaller arteries occurs under the stimulus of their distension (as, for example, the pulsation of the radial artery at the wrist corresponds in time, about, with the second sound of the heart), from these proofs we are to infer, that the pulse is made up of *all* these factors together; there being *a true arterial systole* following consecutively and rhythmically upon that of the heart, and *contributing to*, instead of limiting or restricting, as has been commonly heretofore urged, the onward movement of the blood.

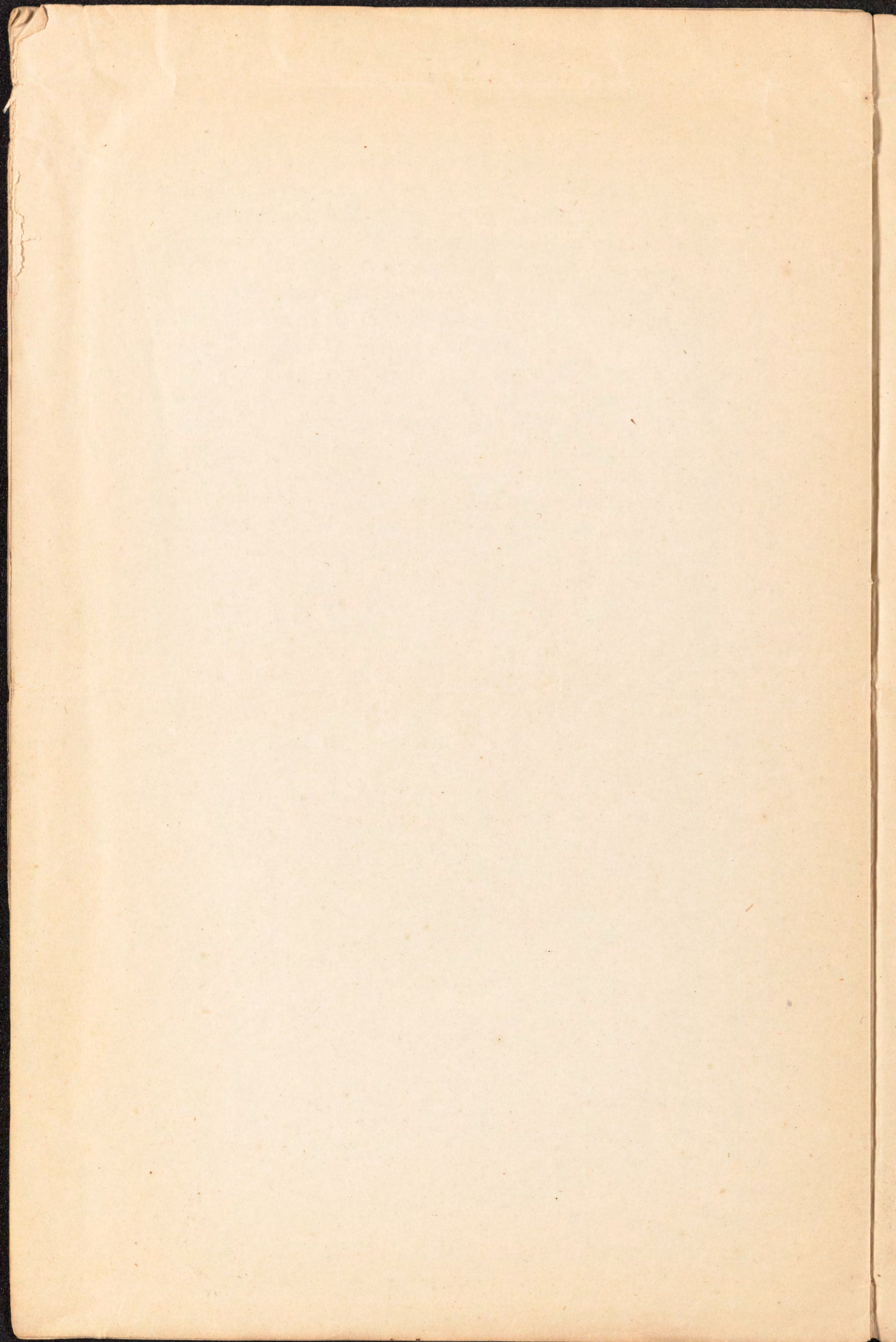
The force of this arterial systole may be estimated by means of a simple observation of Sir Charles Bell's, cited in my previous

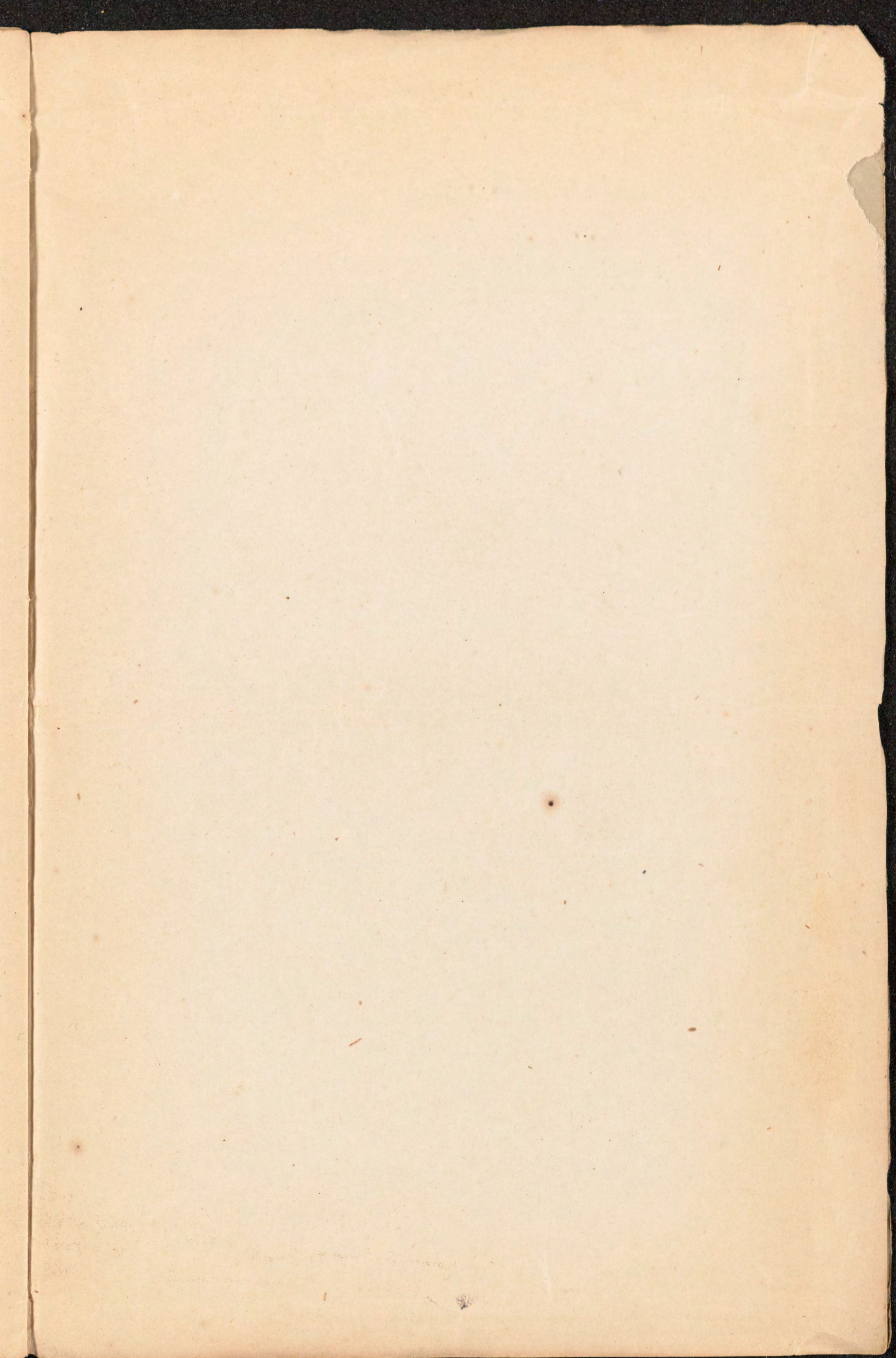
¹ Dr. Bright found 52 of 100 cases of "Bright's disease" to have hypertrophy of the left ventricle; 34 of them without valvular disease.

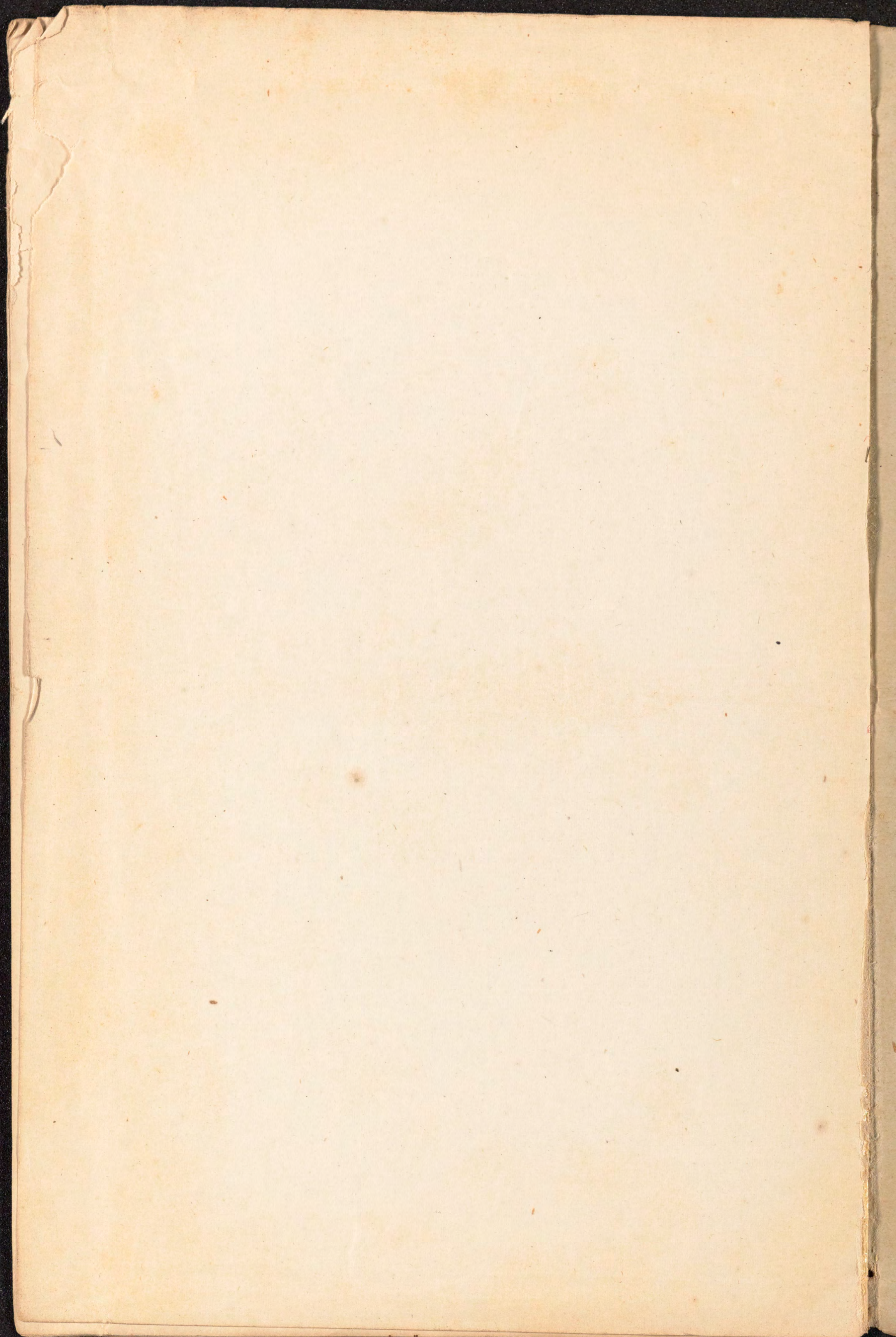
Essay. When, in the sitting posture, one leg is crossed over the other at the knee, it will be seen to move decidedly with every pulsation of the heart; and this will still occur, even when a hundred pounds' weight is suspended to the foot. Yet but one-fifth of the power of the left ventricle can be expended towards producing this movement; and a very small fraction of such a weight will suffice to control the femoral artery at the groin. Hence the motion referred to must be chiefly due to the power of the arterial action throughout the limb.

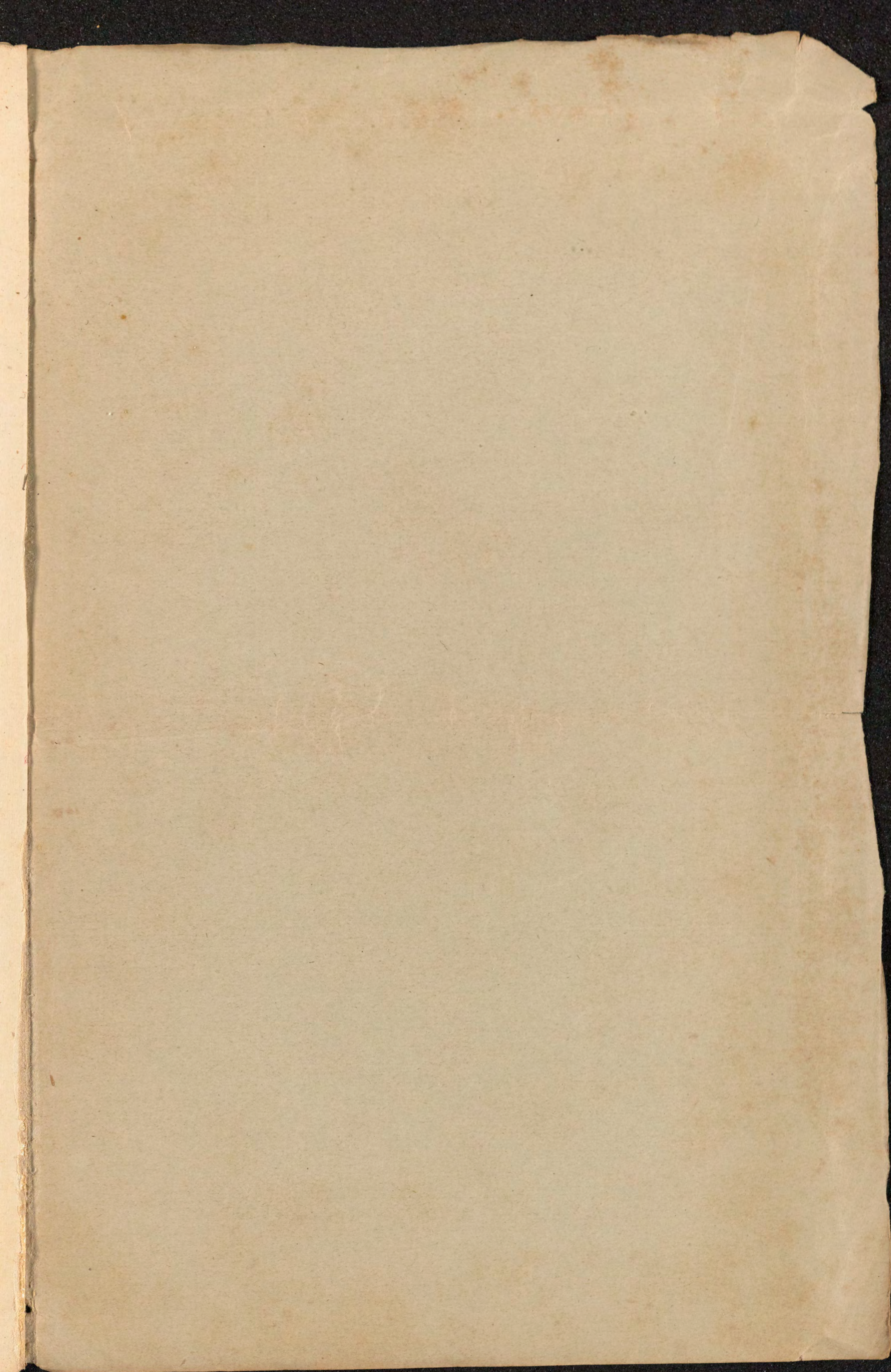
All that there ever has been really in favor of the so-called "stopcock" function of the arteries, was the hasty interpretation of some galvanic experiments of the Webers, more than twenty years ago. When the conclusion which I now anticipate shall have become universal and final, it will indicate that, to make the experimental method fruitful in physiology, there must be combined with it a certain breadth and carefulness of reasoning, not always sufficiently regarded as essential to such investigations.











RHYTHMIC MOVEMENTS OF THE VENA CAVA.—At a recent séance of the Académie de Médecine (reported in *L'Abeille Méd.*, May 11, p. 180) Dr. Colin read a paper on this subject, going to show the possession of decided contractility on the part of these vessels near the point at which they open into the auricle; a contractility manifesting itself in rhythmical movements which are sustained even after destruction of the bulb (medulla oblongata?) if the circulation be kept up by artificial respiration. These pulsatory movements have a perfect systole and diastole, and are isochronous with those of the heart.

Dr. Colin's paper was criticised by M. Vulpian, who remarked that the ideas were not new, as it has long been known that a contraction of the vena cava precedes by an instant that of the auricle. M. Bouilland drew attention to a paper by himself, read about a year ago, in which he had demonstrated the existence of rhythmical movements in the vena cava of frogs, though he had not observed them in the higher animals. The subject of Dr. Colin's paper was referred to a committee, but that gentleman subsequently remarked that he thought M. Vulpian must be mistaken if he imagined that he had observed these movements to be of a vermicular character. Dr. C. had invariably noticed in his experiments that the contraction operated along the entire length of the sinus of the vena cava at the same time that contraction of the auricles took place. M. Vulpian's error probably arose from his having employed agonized animals.

To this M. Vulpian replied that his experiments had not been made on agonized animals, but on those in whom artificial respiration had been conveniently and carefully sustained.

1874

MEDICAL AND SURGICAL SCIENCE.

The Philadelphia Medical Times is an independent journal, devoted to no ends or interests whatever but those common to all who cultivate the science of medicine. Its columns are open to all those who wish to express their views on any subject coming within its legitimate sphere.

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EDITORIAL.

WHITHER ARE WE DRIFTING?

IN times that are past, the American medical profession was dignified as well as honorable; its leaders men of decorum, whose example was as a bright and shining light that guided the rank and file of the profession in paths of quietness; its code

Galabin

Nature

Aug.

21,

1873

acceptation of the term; in other words, that it does not result from the shock produced by the opening of the aortic valve, but that it is coincident with the flow of liquids, one reason being, as the author remarks, that the most violent impulse in an artificial model or schema of the circulation so communicated, as not to cause any flow of liquid, produces no upstroke, but only a slight quivering of the lever. However, that the primary oscillation of the lever in a sphygmograph trace is not, in a great measure, a genuine representation of the movements in the artery, it is equally impossible to believe, for in very slow pulses, where the main rise is not very decided, this wave is particularly pronounced, being gradual in its rise, and more gradual and paraboloid in its fall. It is also seen equally clearly by employing a reflecting sphygmoscope, in which the ray of light which acts as the long arm of the lever, has no weight, and consequently cannot produce any oscillation. Another great objection is that the notch between the first and second (the percussion and the tidal) waves always occurs at the instant at which the aortic valve closes at the heart,* the time it appears after the commencing pulsation *varying* with the length of the pulse-beat. In fact, the tendency of all observations is to make it evident that the second or tidal wave is a post-systolic act, being the oscillatory indication of the secondary tidal wave, which appears as such in the dicrotic rise, and originates from the closure of the aortic valve, as Dr. Galabin agrees with most in thinking; though Dr. Sanderson holds the very different view that the second beat is a restoration of equilibrium which takes place by increase of pressure towards the heart and diminution towards the periphery, a consequence of the sudden projection towards the capillaries of the blood during the systole.

Dr. Galabin remarks that, "if the sphygmograph used have a secondary spring to keep down the long lever, the tidal wave may be replaced by two or even by a jagged line. Such a spring is better omitted, because it is apt to introduce oscillations of its own." It is this idea which has misled him. Tracings taken as he proposes appear much in favour of his explanation, but they are so because they are in reality less truthful than they might be. We have never seen the least indication of any imperfections caused by the employment of the small spring, but we have seen the "percussion" wave divided into two by it in very slow pulses, the former being a small true shock-rise, and the latter the real primary rise.

In conclusion, we cannot refrain from quoting a remark of Dr. Galabin, which, from the precise way in which it sets the question referred to at rest, is worthy of being quoted in every text-book. Referring to the rhythmical contraction observed by Wharton Jones and Schiff in the wing of the bat and the ear of the rabbit, and its supposed influence in assisting the circulation of the blood, he remarks, "Now a peristaltic wave in a tube would tend to produce a current in the liquid of its own velocity, and it would, therefore, accelerate a slower current, but retard a quicker one. Therefore, no peristaltic wave could accelerate the arterial stream, unless it travelled with the velocity of the pulse-wave. It is thus evident that no such slow rhythmical motions as have been observed could assist the arterial flow. And it is inconsistent with the usual character of involuntary muscle to suppose it capable of transmitting a very rapid wave of contraction,† The arteries themselves indeed, when made to contract by artificial stimulus, do so slowly and gradually."

A. H. G.

AMERICAN EXPLORING EXPEDITIONS IN THE GREAT WEST

THERE are several important expeditions more or less employed upon scientific work in the least known portions of the Western territories. From some of these

* See Proc. Roy. Soc., 1871, p. 320.

* He forgets the resistance (a posteriori) of the closing & closed aortic valve.

† Why may not each aortic & arterial contraction follow the stimulation of the preceding heart-impulse?

River, in Nebraska; the Bad Lands east of the Black Hills and between the North and South Forks of the Platte, in Wyoming and Colorado; and the Great Basin of the Green River, southward from Fort Bridger, bordering Utah. There were also minor trips during this expedition to Green River, in Wyoming, and to the Smoky River, in Kansas, which were productive of valuable results. The third expedition started in the summer of 1871, and again explored the Smoky River region in Kansas, the Green River Basin, above mentioned, and investigated two basins, likewise of the Tertiary age, one in Idaho and the other in Oregon. The fourth was a trip with a comparatively small party in the autumn of 1872. It concentrated at St. Louis, went to Fort Wallace by way of Kansas City, and, receiving escort, proceeded to Smoky Hill Fork. On this expedition some explorations were made near Cheyenne, and several days were spent in researches, with varying success, at Crow's Creek, Colorado.

At the most recent dates the present expedition, leaving North Platte Station on the Union Pacific Railroad, had made a nine days' march through a desert country, undergoing great hardships; had reached the Niobrara River, made investigations on both its banks for more than 100 miles below the mouth of Rapid River, and had returned, laden with fossils, to Cheyenne, expecting to make the next start from Fort Bridge in Wyoming Territory. This expedition may extend its researches, as Professor Marsh informed the writer, to the Pacific Coast, and is not expected to return till late in the autumn.

The expedition known as the Wheeler Exploration Party is under the management of the U.S. War Department, Bureau of Engineering. Its chief is Lieut. G. M. Wheeler, of the U.S. Engineers. The operations of the present season will consist of exploration and survey west of the 100th meridian and south of 40°, principally in New Mexico and Arizona, down to the borders of Mexico. The following are named amongst the scientific force:—Messrs. Henry Leubbers, G. Thompson, J. J. Young, and E. Somer, topographers; G. R. Gilbert, E. E. Howell, J. J. Stevenson, and Oscar Loew, geologists; H. W. Henshaw and John Wolfe, naturalists; B. Gilpin, meteorologist; J. H. Clarke, Dr. F. Kampf, W. W. Marryatt, and Prof. H. B. Herr, astronomical observers. The establishment of an astronomical observatory, substantially built of brick, having three observing-rooms, at Ogden, Utah, will form part of the labours of this expedition, which concentrated its forces to start from Denver in June last.

There is an expedition under command of Capt. W. A. Jones, of the U.S. Engineers, which started from Omaha on the 2nd of June. Its objects are mainly topographical, having direct reference to the Yellowstone National Park; but it may be extended to the Big Horn country, a wild region imperfectly known, and said to be fabulously rich in minerals, situated south of 44°, and between meridians 106 and 108. Among the scientific men attached to this party are Lieut. S. E. Blunt, astronomer; P. Le Hardy, topographer; Dr. C. C. Parry, botanist and mineralogist; and Mr. T. B. Comstock, of New York, geologist.

Whether there is a surveying party under Mr. Clarence King, geologist, still in the Wasatch Mountains, at work on the line of the 40th parallel; whether that of Major J. W. Powell has returned from its investigations having principal reference to the cañons of Colorado; and whether a party that went from Philadelphia—consisting principally of Prof. Joseph Leidy, palæontologist, Dr. Henry Chapman, zoologist, Mr. Joseph Willcox, mineralogist, all of that city, and Prof. Porter, of Easton, Pennsylvania, botanist—is still in the wilds of Wyoming and Colorado, the writer is unable, at the present date, to determine.

New York, Aug. 8

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Territory. Second, in June, 1870, to the Loup Fork

Salmon

1874

Royal Society, April 23.—On some points connected with the Circulation of the Blood, arrived at from a study of the Sphygmograph Trace, by A. H. Garrod, B.A., Fellow of St. John's College, Cambridge.

The author commences by giving a table containing a fresh series of measurements of the ratio borne by the *cardiosystole** to its component beat in the cardiograph trace. These tend strongly to substantiate the law previously published by him, viz., that the length of the *cardiosystole* is constant for any given pulse-rate, and that varies as the square root of the length of the pulse-beat only, being found from the equation $xy = 20\sqrt{x}$ when x = the pulse-rate and y = the ratio borne by the *cardiosystole* to the whole beat.

A similar series of fresh measurements are given in proof of the law previously published by him, that in the sphygmograph trace from the radial artery at the wrist, the length of the *sphygmosystole*† is constant for any given pulse-rate, but varies as the cube-root of the length of the pulse-beat, it being found from the equation $xy' = 47\sqrt[3]{x}$, where x = the pulse-rate, and y' = the ratio borne by the *sphygmosystole* to the whole beat.

By measurement of sphygmograph tracings from the carotid in the neck and posterior tibial artery at the ankle, it is then shown that the length of the sphygmograph in those arteries is exactly *the same* as in the radial; so that the above-stated law as to the length of the *sphygmosystole* in the latter applies to them also, and must therefore equally apply to the pulse in the aorta.

Such being the case, by comparing the equations for finding the length of the *cardiosystole* with that for finding the aortic *sphygmosystole*, the relation between the whole cardiac systolic act and the time during which the aortic valve remains open can be estimated with facility; for by subtracting the shorter *sphygmosystole* from the longer *cardiosystole* a remainder is obtained which can be nothing else than the expression of the

* The *cardiosystole* is the interval between the commencement of the systole and the closure of the aortic valve in each revolution.

† The *sphygmosystole* is the interval between the opening and closure of the aortic valve in each cardiac revolution.

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ON THE REFRACTION OF SOUND*

THE principal object of this paper is to show that sound, instead of proceeding along the ground, is lifted or refracted upwards by the atmosphere in direct proportion to the upward diminution of the temperature ; and hence to explain several phenomena of sound, and particularly the results of Prof. Tyndall's recent observations off the South Foreland.

The paper commences with the explanation of the effect of wind upon sound, viz., that this effect is due to the lifting of the sound from the ground, and not to its destruction, as is generally supposed. The lifting of the sound is shown to be due to the different velocities with which the air moves at the ground and at an elevation above it. Owing to friction and obstructions the air moves slower below than above, therefore sound moving against the wind moves faster below than above, and the bottom of the sound waves will thus get in advance of the upper part, and the effect of this will be to refract or turn the sound upwards ; so that the rays of sound which would otherwise move horizontally along the ground actually move upwards in circular or more hyperbolic paths, and may thus, if there is sufficient distance, pass over the observer's head. This explanation was propounded by Prof. Stokes in 1857, but it was discovered independently by the author.

The paper then contains descriptions of experiments made with a view to establish this explanation.

These experiments were made with an electric ball, over a nearly flat meadow, and again over the same when it was nearly covered with snow, and it was found (as indeed it was expected) that the condition of the surface very materially modified the results in two ways. In the first place, a smooth surface like snow obstructs the wind less than grass, hence over snow the wind has less effect in lifting the sound moving against it than over grass ; and it is inferred that a still greater difference would be found to exist in the case of smooth water. In the second

* On the Refraction of Sound by the Atmosphere, By Prof. Osborne Reynolds, Owens College, Manchester. Abstract of paper read before the Royal Society April 23.—Communicated by the Author.

April 30, 1874]

NATU

time occupied by the ventricle at the commencement of its systole in raising its internal pressure to that of the blood in the aorta, which must occur before the aortic valve can open up. This interval is named the *sypasis*. Its length is found to decrease very rapidly with increase in the pulse-rate, and to become *nil* at a pulse-rate of 170 a minute. An attempt is made to explain these phenomena.

If the above considerations are correct, certain independently obtained measurements ought on comparison to correspond; for by reference to one of the papers in the Society's Proceedings it is shown that the length of the there-termed second cardio-arterial interval (which may be called the second cardio-radial interval, as the artery under consideration was the radial), can only represent the time taken by the second or dicrotic wave of the pulse in travelling from the aortic valve to the wrist. This being so, there is every *à priori* reason in favour of the earlier primary wave taking the same time in going the same distance; which can be expressed in other terms by saying that the length of the first cardio-radial interval, from which that of the *sypasis* has been subtracted, ought to be exactly the same as that of the second cardio-radial interval. That such is the case is proved by the two measurements, which have been arrived at independently, agreeing in all cases to three places of decimals, which is great evidence in favour of the accuracy of the methods and arguments employed.

The latter part of the paper is occupied with the description of and the results obtained by the employment of a double-sphygmograph, by means of which simultaneous tracings are taken from two arteries at very different distances from the heart. The arteries experimented on are the radial at the wrist and the posterior tibial behind the ankle, 29 and 52½ inches respectively from the aortic valves. From the resulting traces the time occupied by the pulse-wave in travelling the difference of distance— $(52.5 - 29) = 23.5$ inches is given—is found to be 0.0012 of a minute in a pulse of 75 a minute, and it is shown that this varies very little with difference in pulse-rate, as other considerations would lead us to expect; it is also proved that *there is a marked acceleration of the pulse-wave as it gets further from the heart.*

By superposing the simultaneous trace from the wrist on that from the ankle, direct verification is obtained of the earlier proposition, that the sphygm systole at the wrist and at the ankle are of exactly similar duration. The peculiarities of the ankle trace are also referred to.

Dalton states that the movement of blood is smaller at

authors have proved that leaves kept in the dark give off a quantity of CO_2 increasing with the temperature, that the quantity of CO_2 given off is comparable to that given off by cold-blooded animals, that the leaves absorb more oxygen than they give off CO_2 , and that they continue to evolve CO_2 in an atmosphere deprived of oxygen.—Facts concerning the vibration of the air in sonorous pipes, by M. E. Gripon.—On a new thermo-electric pile, by M. C. C. Clamond.—On a volume regulator for gas currents, by M. H. Giroud.—On tetra-iodide of carbon, by M. G. Gustavson. This substance has been obtained by the action of tetrachloride of carbon upon dialuminic hexiodide, according to the equation $3\text{Cl}_4 + 2\text{Al}_2\text{I}_6 = 3\text{Cl}_4 + 2\text{Al}_2\text{Cl}_6$; the two substances being dissolved in carbon disulphide. It was described as a red crystalline substance decomposed by heating in the air into CO_2 and free iodine.—New researches on black phosphorus, by M. Blondlot.—Action of pure hydrogen on silver nitrate, by M. H. Pellet. The author stated that a neutral or slightly acid solution of the salt is not reduced in the cold by pure hydrogen, and that an alkaline solution is reduced in the cold to an extent proportional to its alkalinity, elevation of temperature increasing the reducing action.—Researches on soluble phosphates used in agriculture, by M. A. Millot.—On the direct determination of the degree of intensity of explosive mixtures: application of the method to gunpowders, by M. Chabrier.—Action of bromine on dibromsuccinic acid; tribromsuccinic acid, by M. E. Bourgoin. The following substances are obtained by the action of bromine and water on the acid: tribromsuccinic and dibrom-maleic acids and dibrominated ethylene dibromide.—On the alcohols contained in the acid liquors of starch manufactories and in the products of the butyric fermentation of glucose, by M. G. Bouchardat. These are ethylic, normal propylic, and butylic alcohols.—On the determination of alcohol in water, wines and saccharine liquors, by M. Salleron.—General method for the transformation of alcohols into nitric ethers, by M. P. Champion. The reagent employed is nitro-sulphuric acid.—On phenyl-allyl, by M. B. Radziszewski.—On pyrogallol in presence of iron salts, by M. E. Jacquemin.—On the colouring matter of wine, by M. E. Duclaux.—On the volatile acids of wine, by the same author.—Movements excited in the stamens of *Mahonia* and *Berberis*; anatomical conditions of this movement, by M. E. Heckel.—On the direction of the wind in the high and low (atmospheric) regions during the storm of April 13, 1874, by M. Chapelas.—During the meeting a commission was appointed to prepare a list of candidates for the vacancy of *fermier* caused by the death of M. De la

Gaborandi contracts, atropia dilates, pupil.
" excites heart, flushes & increases secretion.
Atropia "paralyzes" heart & arteries - enfeebling blood flow.

ACTION OF ESERINA IN CHOREA.—Dr. E. Bouchut
 (*Bull. Gén. de Thérap.*, April 13) records the results of
 four hundred and thirty-seven observations upon the
 action of eserina (the active principle of calabar bean),
 particularly in the chorea of children.

He finds that this alkaloid, while diminishing mus-
 cular contractility, augments that of the smaller vessels.
 It may be employed hypodermically or by the stomach,
 and should be given fasting. It may be given hypoder-
 mically in the dose of one-twentieth to one-twelfth of a
 grain, and, as its effect only lasts one to three hours, the
 dose may be repeated until one-fourth to one-third of a
 grain is given in twenty-four hours.

The effects of eserina are observed within a few min-
 utes from its administration, and these are constant in
 the dose of one-twentieth to one-twelfth of a grain. It
 usually produces paleness, with contraction, occasion-
 ally followed by diminution of rate in the pulse. Nearly
 all the children to whom eserina was administered ex-
 perience malaise, burning pains in the epigastrium,
 with gastralgia, nausea, and rejection of stringy sputa.

Eserina occasionally causes bilious vomiting; it does
 not modify the temperature sensibly. In the doses
 above mentioned, eserina never produces colic or diar-
 rhœa. Given internally, it usually produces no effect
 upon the pupil. It frequently causes profuse perspira-
 tion of the face and body. Paresis, and occasionally
 transitory paralysis of the diaphragm, are among the
 most serious and painful phenomena produced by this
 remedy.

* This same diatom is also abundant in the Toome Bridge, Ireland, de-
 posit (fossil?), though the books do not mention that it has ever been found
 in Europe.

X But paleness may be produced by
 diminishing muscular action of arteries.
 Cf. prevention of arter. hemorrh. after r.t. accident.

very fine longitudinal striæ, which can be seen only with a good instrument and with very careful management of the illumination. When these are in sight the transverse lines are *absolutely invisible* with the very best glasses; and with the best it can be demonstrated that Hartnack's "flat hexagons" have no existence, and were a theoretical explanation. The longitudinal striæ are not continuous, but interrupted at frequent intervals. This may be owing to the inequality of the surface of the plant. I explain the appearance of the dots or beads as caused by the intersection of the two sets of striæ on different planes with each other, so illuminated that the light is partly received from each. If true beads existed as represented in the photograph, it is difficult to conceive of any illumination that could cause them to disappear. The study of other genera of the Diatomaceæ only confirms me in this opinion. *Navicula cuspidata* Kutz is a well-known form, described as having "very fine transverse striæ." My friend and correspondent J. E. Smith, of Ashtabula, Ohio, discovered that this species has exquisitely fine longitudinal lines also. By certain illumination this may be made to show "dots." Examined with a one-fiftieth, I demonstrated conclusively that the two sets of striæ are on different planes, either of which could be brought into focus *without the other*. That there are a vast number of species of diatoms with true "beads," I admit.

at the top. Violent muscular spasms were shortly produced; he began to hold his breath; his face became livid. Artificial respiration by Silvester's method was tried, and continued for three-quarters of an hour, as a faint flickering pulse was felt at the wrist when the movement of the arm became less violent. The heart never recovered its action.

Post-mortem examination showed the right side of the heart gorged with fluid blood, but otherwise quite healthy. The lungs were deeply congested.

Millie-Christine.—These two girls, joined together at the sacrum, who were exhibited a few years since in this country, are now on exhibition in Paris; and MM. TARDIEU and ROBIN communicated to the Académie de Médecine, Jan. 13th, the results of their examination of this monstrosity. Much opposition was made to the examination by the exhibitors ("the Barnums") and only succeeded through a written order of the Prefect of Police.

They were permitted, however, to strip the girls only as far as the hips, but they ascertained some interesting particulars.

The two girls, 22 years of age, are united at the sacrum. The upper portions of the bodies are separate; they have two hearts, which do not beat in unison, and the radial pulse in the two is not isochronous, while there is complete synchronism in the pulsation of the arteries of the lower extremities in both subjects. The sensibility of the upper limbs is distinct and separate in each subject, while any impression on the lower limbs is felt at the same time by both subjects. MM. T. and R. endeavoured to persuade the girls to permit an examination of their pelvic region, and one seemed inclined to assent, but the other most indignantly refused, showing each had her own independent will.

The woman who attends these children stated that they menstruated regularly at one and the same time; and they experienced a desire for defecation and micturition at the same time.

M. Broca added some interesting particulars. He thinks that there exists a certain degree of fusion of the extremities

X Therefore, either the tibial arterial pulses keep time with neither radial pulse — or else at least one radial and one tibial pulse are non-synchronous in the same bodies.

impulse was not to be felt over the chest, and even with difficulty heard on applying the ear to the chest wall. The sound might be likened to a blowing sound, or a murmur, or to a heart heard at a very great distance, or through a stone wall, both sounds lapsing into one.

“Respiration was full and easy, and was well maintained throughout. The pulse respiration ratio was borne out throughout.

“The sufferers were sensible to the last and throughout. One case terminated with a slight convulsive effort. All sat up before dying, falling back in less than an instant. No headache was complained of. Muscular strength was retained. They were all able to sit up, lift a cup to their lips, or even walk.

“They were perfectly sleepless. In two recoveries there appeared a pustular eruption on the face and lower extremities, resembling in its character poisoned wounds.

“In the case of the boy Thyer, while sawing wood, an hour after drinking the wine, he was seized with violent retching and vomiting succeeded by a ‘fit,’ which from the description resembled a convulsive attack. Thumbs were turned in, with the fingers closed over them.”

The symptoms in every case were proportionate to the amount of wine taken.

All the fatal cases terminated in from 19 to 28 hours.

—
Deaths from Chloroform.—Two cases of this have recently taken place in New Zealand. One occurred in the Provincial Hospital in a man suffering from epithelial cancer of the lip; the second in Dunedin Hospital during an operation for removal of cancer of the breast.—*Brit. Med. Journ.*, Jan. 31, 1874.

In the *Lancet* for January 17, 1874, is reported the following case, which occurred at the Bristol Royal Infirmary:—

Albert T——, mason, aged 30, was admitted with stricture. It was decided to place him under the influence of chloroform, to try to introduce an instrument. Heart sounds were perfectly healthy. Two drachms of chloroform were administered in a sponge tent with a large hole

THE LOCALIZATION OF THE VASO-MOTOR CENTRE.—
Experimenting upon frogs, Dr. Moritz Nussbaum
(*Archiv für die Gesamte Physiologie*) found that when
the spinal cord is divided at its upper extremity by the
galvano-caustic loop, and the medulla oblongata and
brain carefully removed, intense contraction of the
arterial walls takes place, observed under the micro-
scope, in the interdigital membrane. This generally
occurs within five minutes after the section, and is soon

Wissens., NO. 277

India-rubber cloth was first applied in the treatment of cutaneous affections by Dr. Colson, of Beauvais, and both Hardy and Hebra have since attained satisfactory results from its use. Besnier during the past two years utilized the immense material of the Hôpital Saint-Louis for experiments as to the value of this mode of treatment, and especially prizes gum cloth as a substitute for poultices and the continual bath. He employs for the most part the vulcanized cloth, and only gives the preference to that which is not vulcanized when the

succeeded by a period of dilatation, lasting about two hours. The nervous system of the frog has now had time to recover from the shock of the operation, and *the rhythmical contractions of the arteries again take place*, as in uninjured animals observed by Schiff and others. That this is produced independently of the action of the general muscular system, is shown by the fact that it occurs also under the same conditions in curarized animals, in which, also, *mechanical, chemical, and electrical irritation of the sensitive nerves are followed by arterial contractions*. After extirpation of the entire central nervous system, the tone of the vessels disappears, the preceding results from irritation of the sensitive nerves are naturally wanting, and the circulation ceases in twenty-four hours at the latest.

Dr. Nussbaum considers that it is therefore certain that the spinal cord, like the medulla oblongata, is individually concerned in the innervation of the vessels, and that the medulla oblongata contains only the upper end of the vaso-motor centre.

W.

will give her a limb which will enable her to walk without any difficulty.

SERVICE OF MR. BRYANT.

A CASE OF DISEASE OF THE TESTICLE—REMOVAL OF THE ORGAN.

This man for three months has had trouble in the left testicle, which is swollen and is the seat of pain of a peculiar dragging character. There is no history of syphilis. The tumor, which of late has been increasing in size, feels heavy, is not translucent, and is hard and tense, though slightly elastic to the touch; at its lower part it feels as though there was a cyst containing thick fluid.

The trouble here might be due to a collection of fluid in the tunica vaginalis, and to syphilitic, cystic, or carcinomatous disease of the testicle itself, but the symptoms and the examination seem to point to the existence of the last rather than the other affections. The pain of which the patient complains in the region of the
hips might be attributed to a carcinomatous involve-

(omit in lectures)

TIMES.

Lower's exp. 1880 437

ascites to be produced by tying the vena cava within the thorax of a dog; and, in the other, that ligature of both jugulars was followed by œdema of the parts above the ligature, and by increased tears and saliva. This theory received the support of Bouillaud in 1823, who described cases of local œdema resulting from thrombosis, and attributed its occurrence to clots in the interior of the veins preventing them from performing their absorbent function.

Ranvier obtained very different results from the repetition of Lower's experiments. Neither ligature of the jugulars nor of the femoral was followed by œdema. On tying the inferior cava, taking care not to injure or include the nerves, both legs became cold, but no œdema resulted. If, however, one of the sciatic nerves—which Bernard has shown to contain the vaso-motor nerves of the leg—was then cut, the cutaneous vessels of that leg dilated, the color of the limb became rosy, and it felt hot instead of remaining cold like the other. Within an hour œdema was noticed about the tendo-Achillis, and in twenty hours the leg had become intensely swollen. To show that this effect was due to division of the vaso-motor nerves of the leg, and not to the paralysis consequent on the division of the motor fibres of the sciatic, the experimenter divided the latter class of nerves and left the vaso-motor unharmed. There resulted complete paralysis of the leg, but no œdema occurred. These experiments seem to show that venous congestion alone is not sufficient to produce œdema. The experiments of Goltz, now to be mentioned, support the view that the œdema which followed the section of the nerve was due to an unusual amount of fluid being poured out from the dilated vessels.

Goltz rendered two frogs motionless by poisoning them with curare, and then destroyed the brain and spinal cord of one, while he left those of the other unharmed. He then injected a solution of common salt into the lymph-sac of each, and found that from the divided aorta of the one whose brain and spinal cord had been destroyed not a drop of fluid fell, though the hearts of both continued to beat, while from the other at first pure blood, then diluted blood, and at last a colorless fluid, flowed, and that just in proportion as the fluid which trickled from the aorta filled the vessel which was placed to collect it did that in the lymph-sac diminish. Having thus shown that destruction of the nervous system arrests absorption, he also found that when the nervous centres were stimulated the rapidity of absorption was much increased.

In some additional experiments, he found that destruction of the nervous system allows fluid to exude more easily from the vessels, as well as hinders its absorption into them. This result coincides with those attained by Ranvier.

Then the vaso-motor nerve-influence promotes active blood-movement.

Calabar bean, either with or without the addition of ergot. He believes that such remedial agents as have the power to diminish excitability, and at the same time to increase the vascular tonicity, exert the most favorable influence over the active stages of its progress. Such are the Calabar bean, cannabis indica, gelsemium, ergot, etc. In the active stage of the disease he has not found either opiates or quinine to produce any favorable effects.

DR. S. C. BUSEY, of Washington, D.C., reports, in the *National Medical Journal*, a case in which a girl six years of age ate, on the 8th of November, some "chicken-grapes." Two days after, Dr. B. was called to see her, and found a mass of the grape-skins and seeds impacted in the rectum. Other means failing, and a tendency to colitis showing itself, on the 12th Dr. Busey removed the whole mass, about a pint, with his finger and a scoop-director. The operation was followed by very slight bleeding, and by some pain; but the child was playing about the same afternoon, and recovered without any bad symptom.

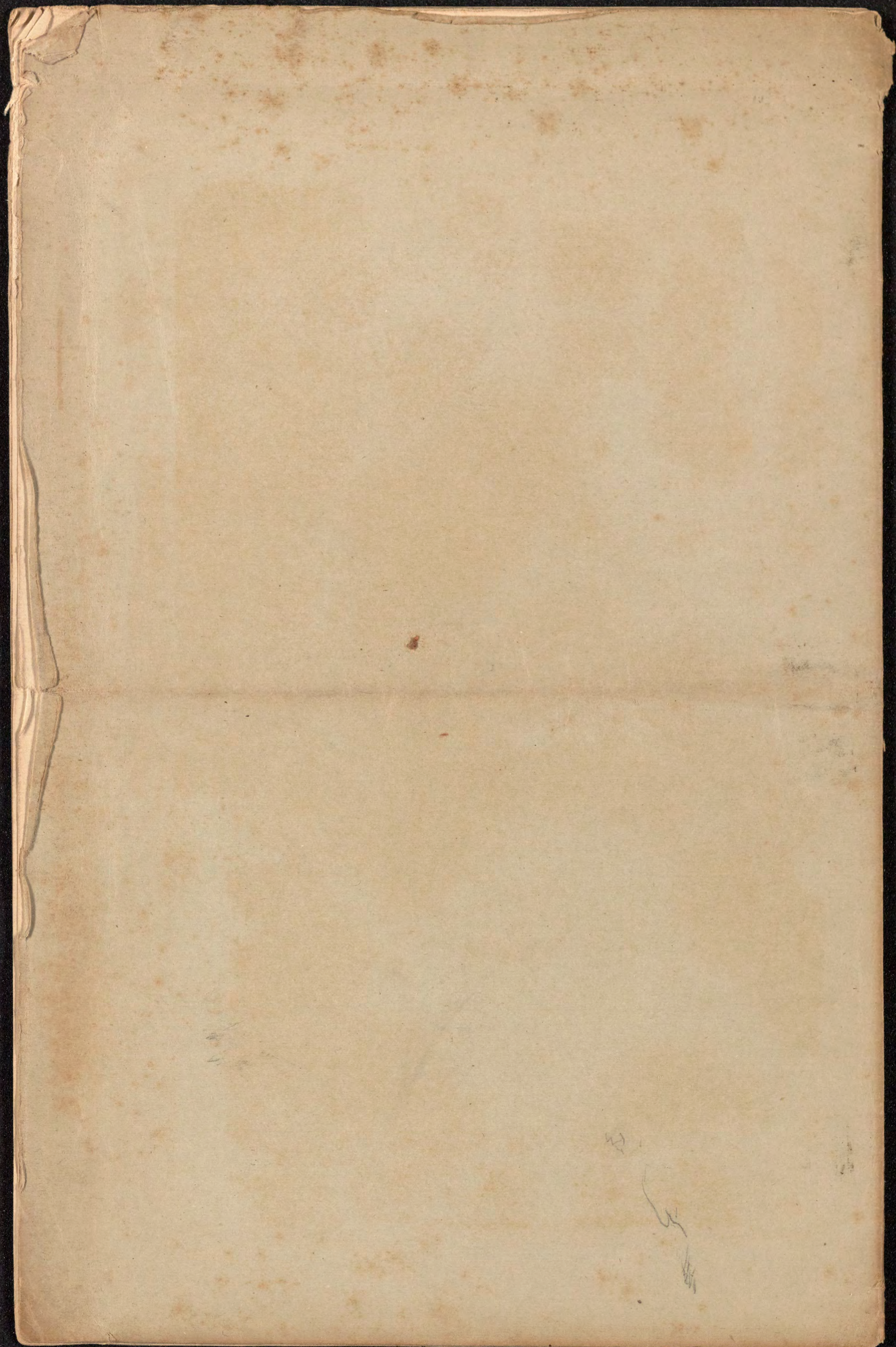
An older sister of this child had also eaten very heartily of the grapes, and a similar accumulation had taken place; but she discharged the mass by a voluntary effort.

VAPOR OF AMMONIA IN HOOPING-COUGH. — Mr. John Grantham states in the *British Medical Journal*, that in cases of whooping-cough in the last stage (that is, after the third week) he has had one ounce of the strongest liquid ammonia put into a gallon of water in an open pan, and the steam kept up by means of half a brick made red-hot throughout and put into the boiling water containing the ammonia, the pan being placed in the centre of a room, into which the patients were brought as the ammoniated steam was passing off. "This method was used in the evening, just before bedtime; and it has been so efficacious," he says, "in abating the spasmodic attack, and after three or four days terminating the malady, that I cannot over-estimate the great value of this mode of inhaling the ammonia as a therapeutic agent in tranquillizing the nervous system in whooping-cough."

CINCHONA CULTIVATION AT ST. HELENA. — The British government has established a cinchona plantation at St. Helena, at an elevation of twenty-six hundred feet above the sea. The *London Journal of Botany* states that there are now nearly one thousand trees in a fine healthy condition, the tallest between seven and eight feet above the ground. The nature of the land forming the plantation is very steep and rugged. The entire cost of the trees, exclusive of the superintendent's salary,

Never mind
this is
Lectures

Keep her out in lectures

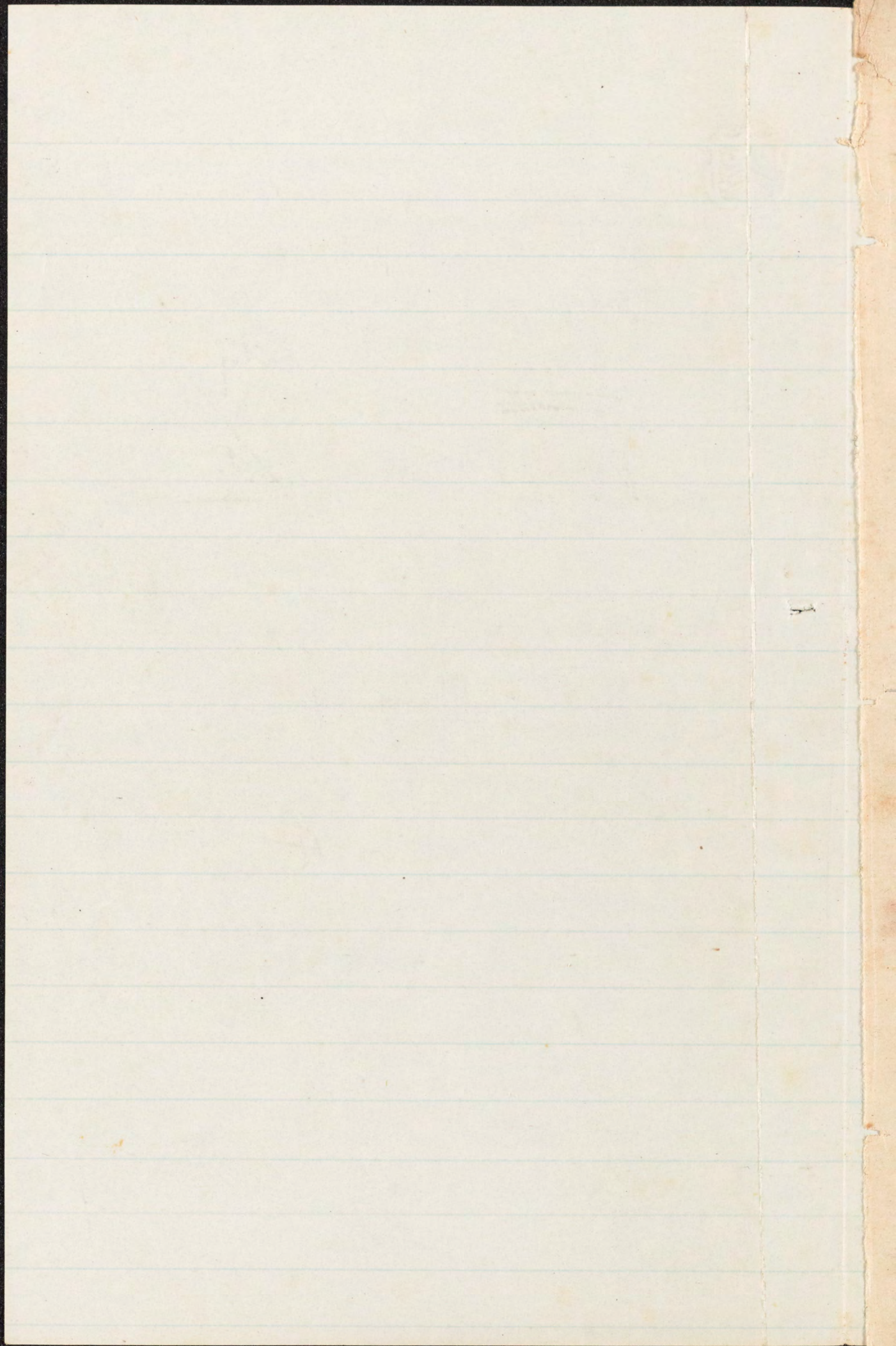


(10)

P.

Capillaries -
veins -

Look first to
black / pap.
upper. arteries



and heat upon the circulation, through the ganglia, are founded; making the basis of the "ice-bag" and "hot-water-bag" practice of Dr. John Chapman. Neither the practice nor the theory is as yet established; nor does the one necessarily depend upon the other.

The Capillaries.

Having but a single coat, without muscularity, these intermediate vessels can have no office but to subdivide, in fine networks,

Fig. 124.



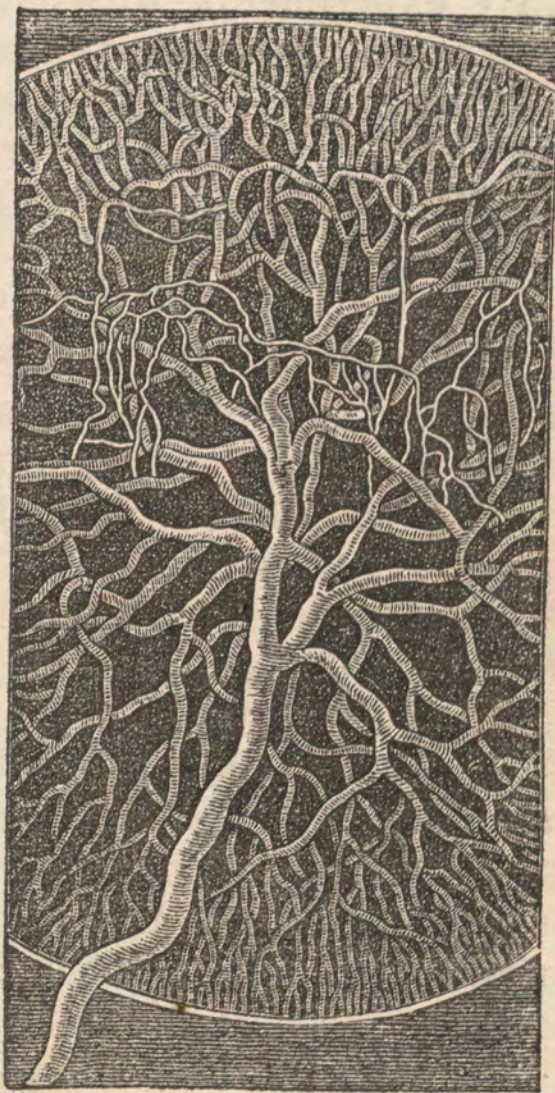
CAPILLARIES.—*a*. Capillaries of the papillae of the skin of a finger. *b*. Capillaries of villi of small intestines.

the blood; so that it may afford nutriment, by transudation of the plasma through their walls; or, in the glands, allow secretion; or, in the lungs, expose the blood to the air. Capillaries contract only by elasticity; so as, after being dilated, to return, on the withdrawal of pressure, to their ordinary dimensions.

Yet, two powers have been pointed out as, in the capillary region, contributing to the movement of the blood. One of these, as shown by Dr. Draper, is common to plants, animals, and some materials of an inorganic nature; viz., capillary action; that is, the attraction of the walls of fine tubes for liquid in which they are immersed, varying with the smallness of the tube and the nature of the materials used.

The other agency, first pointed out by Dr. Draper, is also present both in animals and plants. It is

Fig. 125.



CAPILLARIES OF A TOOTH.

the attraction which the tissues of the organism have for the nutritive materials circulating in its vessels. This "vital or nutritive affinity" is a *vis à fronte*; which, as it constantly takes, in nutrition, particles from the blood in the capillaries, must diminish pressure in resistance, and favor the onward flow.

The Veins.

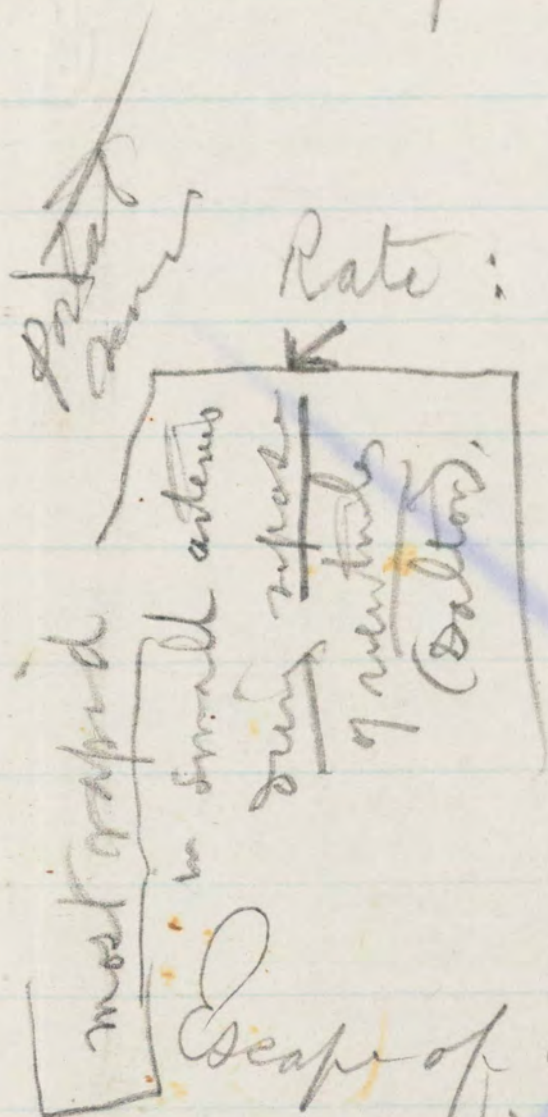
Valves along the course of nearly all the veins, opening only towards the heart, economize the power used in returning the blood through them (from the capillaries) to the heart. The pressure of the muscles during exercise contributes to the same end. So does *inspiration* tend to promote the return of the blood through the *venæ cavæ* to the heart; since the lifting of the ribs lessens the pressure upon the heart's surface, or, in other words, exerts some "suction" power upon it. The *larger* veins have an appreciable amount of muscular tissue; the smaller ones, none. It is natural to suppose that this is because the largest, being nearest the end of the round of circulation at the heart, require the most power to complete the circuit. The *velocity* of the blood-movement is greater in the arteries than in the veins. The *capacity* of the venous system is about three times as great as that of the arterial system; and the angles at which branches join the veins are much larger than those at which branches leave the arterial trunks. These facts account for the greater slowness of the venous current.

By experiments with chemical reagents introduced into the veins, it has been shown that the blood passes round its course in *less than half a minute*, in some instances, and in others in about a minute. It is not equally rapid at all times, nor even through all the different organs of the same body.

Route of the Circulation.

Although perhaps not necessary in this place, we may recapitulate the round of the circulation, as follows: Beginning at the aorta, the blood is distributed by its branches to all parts of the body. The small arteries terminating finally in capillaries, these, in various networks, subdivide the blood for the supply of the different organs. Then the capillaries unite to form veins, and these, larger ones, till finally all combine to end in the ascending and descending *venæ cavæ*. These empty into the right auricle. This pours its blood through the tricuspid valve into the right ventricle; which, by the pulmonary artery and its branches, sends it to the lungs. Thence, by the four pulmonary veins, the blood is brought to the left auricle. Through the mitral valve, it is passed on into the left ventricle; whence it again is thrown into the aorta. The *portal* circulation of the liver is, as has been already explained, a deviation from this simple course of the general system; since the portal vein, instead of going to empty its contents

Capillary area is to arterial
as 300 to 1.



Escape of corpuscles (white oftenest, sometimes red) observed first by Waller (1846) — migration of leucocytes mentioned later by Recklinghausen — but most attention called to it in inflammation by Cohnheim, 1867. Most probably morbid, pathological, only: especially under excessive local blood pressure. Burdon Sanderson suggests that the capillaries ~~are~~ ^{being} not dead conduits, but tubes of living protoplasm, their walls may yield & close again, without stomata or actual ruptures.

~~At Haverford, 1874, supply,
here, assimilation and nutrition;
also, compar. physiology of digestion
(beginning with prehension) and that of
circulation of the blood.)~~

P. (17)

11

Respiration

Types of blood aeration:

Protozoan — all over —

< Dorsibranchiate molluscan —

Insect — tracheal —

> Fish — by gills — (anabas, &c)

Frog, Salamander, (Turtle) (Perennibranchiate)
not so

Bird — air sacs, lungs expand & hollow bones —

Mammal & Human —

Snails & spiders

↑ pulmonary sacs

~~X — X~~

- | | | |
|--------------------|---|-------------------------------------|
| 1. By air-membrane | { | Protozoa |
| 2. Tracheal | | Insects & some arachnids |
| 3. Branchial | | Fishes, many molluscs, crustacea &c |
| 4. Pulmonary | | Mammals &c |

directly into the venæ cavæ, breaks up into capillaries to enter the liver; whose blood is then collected by the hepatic vein, by which it is conveyed to the vena cava.

The discovery of the course of the circulation was made by Dr. William Harvey, about 1619.

CHAPTER III.

RESPIRATION.

THIS function has for its purpose the aeration of the blood. It is accomplished by the exposure of the venous blood, brought from the right half of the heart, to the air received into the air-vesicles of the lungs. The immense number of these vesicles (about six hundred millions), provides a very large expansion of surface. Air and blood both periodically enter and pass through the lungs; although the blood is entirely confined within the capillaries. The heart sends a new supply of venous blood with every systole; the lungs receive a fresh quantity of air with each inhalation.

Movements of Respiration.

These are, *inspiration* and *expiration*. The first is accomplished by expanding the chest, so as to take pressure from the outside of the lungs, while the mouth or nostrils are open to allow the entrance of air. It is precisely the action of filling a pair of bellows with air by drawing apart the handles. This expansion of the chest is effected in two ways: 1, elevation of the ribs by the intercostal muscles; 2, depression of the diaphragm by its own contraction.

The intercostal muscles, internal and external, have their fibres crossing in opposite directions. This obliquity adds to the extent of their action in lifting the ribs; as every muscle shortens, in its

Fig. 126.



DIAGRAM OF AIR-CELLS —1. Small bronchial tube. 2. Vesicular portion of lobule. 3. The same, laid open.

contraction, about one-third of its length, therefore the longer it is, the greater the distance through which it draws what it moves. Breathing chiefly by action of the intercostal muscles in lifting the ribs is called *costal* respiration; by the diaphragm mainly, *abdominal* respiration. The latter is observed in young children; the costal type, in women. Abdominal respiration is so called, because, when the diaphragm descends, it forces out the organs of the abdomen perceptibly.

In violent efforts of inspiration, as in asthma or croup, accessory muscles of respiration assist the intercostals and diaphragm. The principal of these are the *levator costarum*. But other muscles may contribute aid—even those of the neck; and sometimes the nostrils are forcibly dilated in the struggle for air.

Ordinary *expiration* follows the cessation of the muscular act of inspiration, not requiring any positive effort of muscular contraction. The weight of the ribs causes them to fall; the elasticity of the diaphragm makes it ascend; the same property in the lungs induces their contraction and the expulsion of the air. The elasticity of the costal cartilages also assists. *Forced* expiration, however, as in blowing hard, involves (besides the accessory action of the *sterno-costalis* muscle) compression upward of the diaphragm, by the superficial *muscles of the abdomen* (external and internal oblique, transversalis, and rectus) pressing in the contents of the cavity under them.

Lower intercostals (Dwight) and the
Quantity of Air Changed. *thirty to thirty-five*

With each breath, a man changes about ~~twenty-five~~ cubic inches of air. By forced expiration, one can expel a much larger amount. Still a quantity will remain in the lungs, which cannot be driven out. This *residual* air varies probably from forty to two hundred and sixty cubic inches.

After a deep inspiration, a healthy man, five feet seven inches in height, can, on the average, expel from his lungs two hundred and twenty-five cubic inches of air. This was called, by Mr. Hutchinson, the *vital capacity*. For every inch above the height just named, the capacity of the chest increases about eight cubic inches; and for every inch below, it is diminished in the same proportion. Less regular correspondence exists in regard to weight. Mostly it does not vary much with weight under one hundred and sixty-one pounds. Over that, each additional pound of weight brings a cubic inch of diminution in vital capacity, so called. With age, this increases from fifteen to thirty-five years, at the rate of five cubic inches per year. Then it diminishes, one and a half cubic inches each year, to sixty-five years. Bourguery states that women have but half the breathing capacity of men of the same age.

The *number* of respirations usual in an adult in health is from fourteen to eighteen in a minute. The *force* of ordinary

a full, deep

The intercostals were then examined. Having been exposed from the median line to the line of the axilla, the interrupted current was applied to the inter-cartilaginous portion of the internal intercostals by means of small sponges, when it was found that they all raised the cartilage below them. The external intercostals were then faradized, when the upper rib was pulled down very markedly, while the lower one was just perceptibly raised; the movement increased from the first to the seventh, the last four not being examined. These experiments seemed to point to the conclusion that the internal intercostals are inspirators, and the external expirators.

Dr. McKee

Neander

1875

PHILADELPHIA COUNTY MEDICAL
SOCIETY.

CONVERSATIONAL meeting, Wednesday, January
13, 1875.

VICE-PRESIDENT DR. J. S. ESHLEMAN in the chair.

Placenta prævia.

Dr. J. S. ESHLEMAN related a case of placenta prævia which he had treated in consultation with Dr. I. McGuigan. They met very soon after the first profuse

regards the
The third part of the inquiry, although the most important, is incomplete. It has for its object to determine, by direct comparative measurements of the lengths of the sternal ribs in the states of inspiration and expiration respectively, whether the inferred inbending actually takes place. Dr. Ransome has employed callipers specially constructed for the purpose. He states, in anticipation of the publication of the detailed results of his measurements, that they afford distinct evidence that man possesses the power of constricting his chest by bending his ribs inwards. It is highly desirable not only that the investigation should be continued, but that it should be extended from the human subject to other mammalia; for in the lower animals it could obviously be carried out with greater accuracy. The bending of a bone by a voluntary muscular act appears *prima facie* so improbable, that it cannot be accepted except on the most positive evidence. Dr. Ransome attributes the supposed inbending of the ribs to the interosseous part of the internal intercostals, arriving at this inference mainly by exclusion. As regards these muscles, it is to be borne in mind that, although we know that the intercartilagenous fibres are inspiratory, because Haller saw and felt them contract in inspiration, the usually accepted belief that the interosseous fibres act as constrictors of the chest has not been proved.*

J. BURDON SANDERSON, M.D.

Lower
intercostals
H.H.

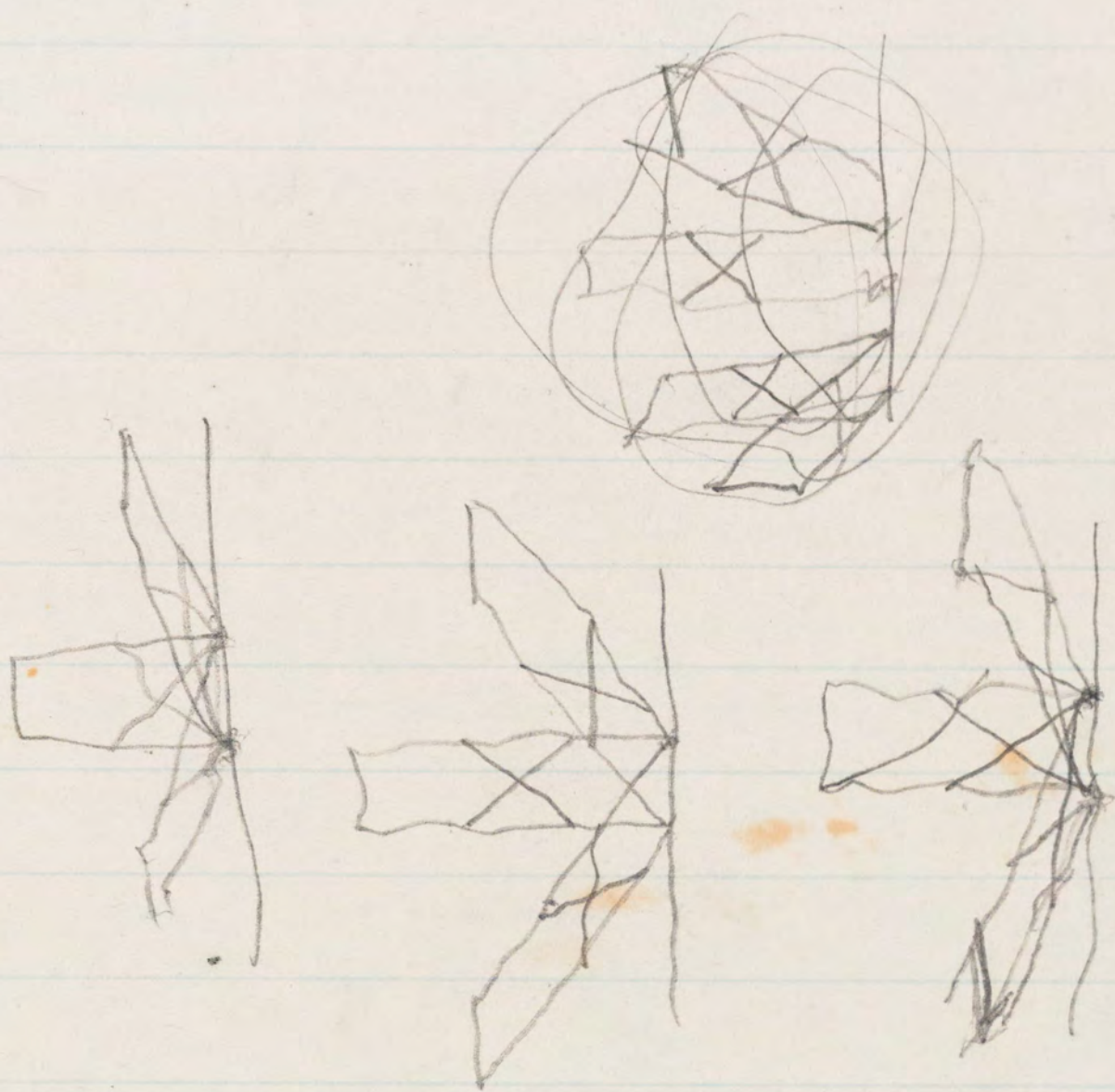
In this paper the author communicates a summary of the physiological results obtained by him with the aid of his instrument for the simultaneous measurement of the forward, upward, and outward movements of any point on the wall of the chest in forced breathing. The most important are those which relate to the movements performed by the sternal ribs in forced inspiration, when the spinal column is kept motionless. It was ascertained, by measurements made with the instrument already referred to, that in the performance of the act of expansion in a healthy adult male, the upward movement of the tip of the third rib may amount to 1.6 in., and of the fifth rib to 1.2 in.; and the forward movement of the former to 1.25, of the latter to 1.15 in. By the act of expansion is here meant, not the movement executed by the chest in passing from the state of equilibrium (*i.e.*, from the condition assumed by the chest after ordinary expiration) to that of extreme inspiration, but a movement which takes its start from extreme expiration. It is not therefore a merely intensified or exaggerated form of an ordinary inspiration. It depends for its extent on two perfectly distinct voluntary acts; namely, 1. the antecedent contraction of the muscles concerned in extreme expiration, and 2. that of the ordinary and extraordinary muscles of inspiration, particularly those which act on the upper part of the thorax. Consequently, the motion itself is not of the same nature throughout. The first part is dependent on the return of the chest from the

Respiration and Versification. — The natural rate of respiration is from sixteen to twenty-four breaths per minute, the average being twenty. To this fact Dr. Oliver Wendell Holmes attributes the favor in which the octosyllabic verse is held: that verse, more exactly than any other, follows the natural rhythm of respiration. Experiments with the poetry of Scott, Longfellow, and Tennyson, show that an average of twenty lines will be read in a minute, so that one respiration will suffice for each line. It is, in fact, so easy of articulation, that it is apt to run into a sing-song. The twelve-syllable line of Drayton's "Polyolbion" is pronounced almost intolerable, on account of its "intensely unphysiological construction." Dr. Holmes's conclusion is, that nothing in poetry or in vocal music is popular that is not calculated with strict reference to the respiratory functions.

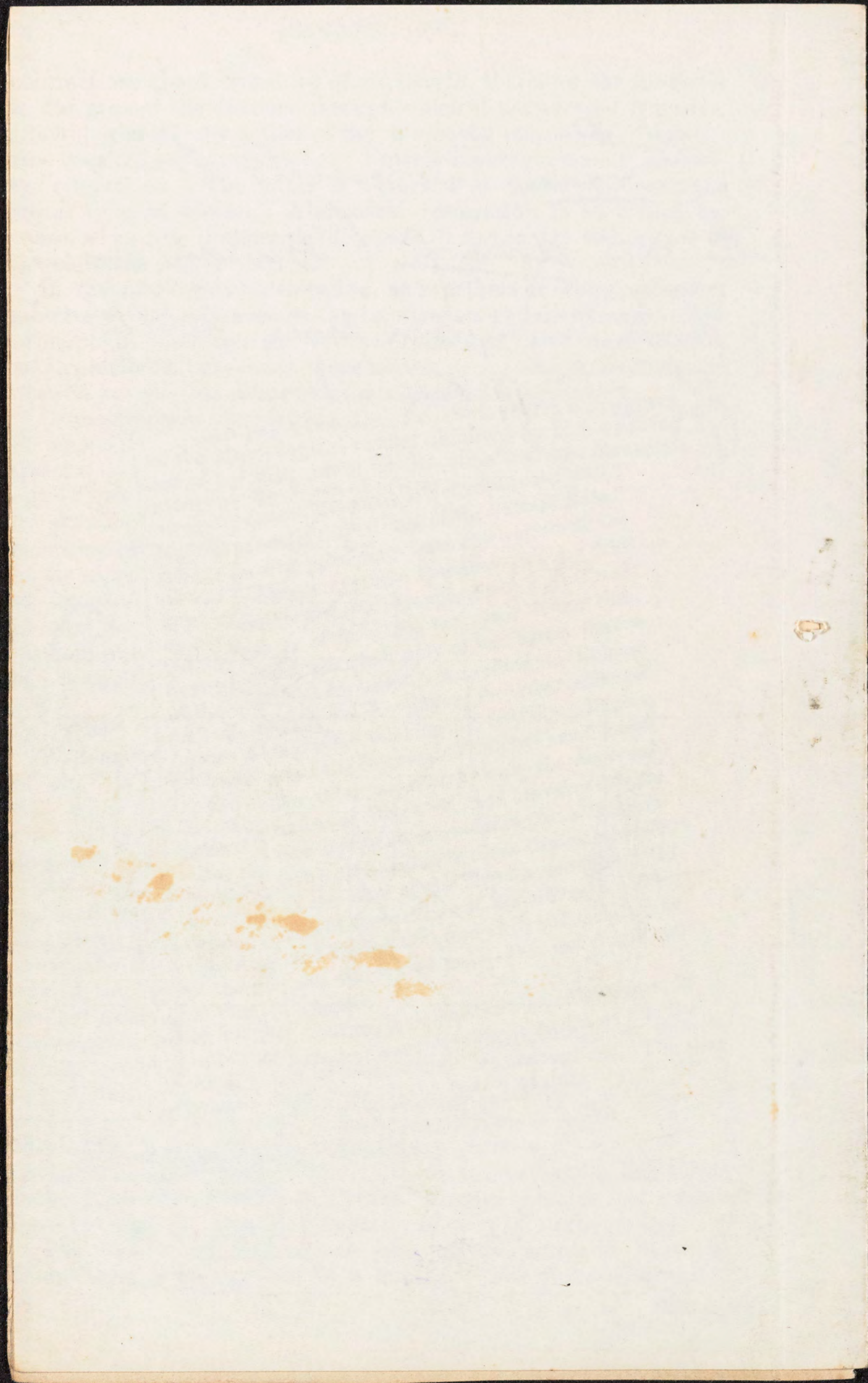
Sciences, Mr. Charles Wolcott Brooks read a paper on the "Origin of the Chinese Race," in which he very learnedly set forth the evidence of their American origin. The author's thesis is supported by a great multitude of facts, but the space at our command will admit only of the barest outline of his argument. According to Chinese annals, Tai Ko Fokee, the great stranger king, ruled the kingdom of China. In pictures he is represented with two small horns, like those associated with the representations of Moses. He and his successor are said to have introduced into China "picture-writing," like that in use in Central America at the time of the Spanish conquest. He taught the motions of the heavenly bodies, and divided time into years and months; he also introduced many other useful arts and sciences.

Now, there has been found at Copan, in Central America, a figure strikingly like the

Lowe intercostals draw
the ribs downward (Dwight) -
proved in my own case with
fracture of 6th rib -



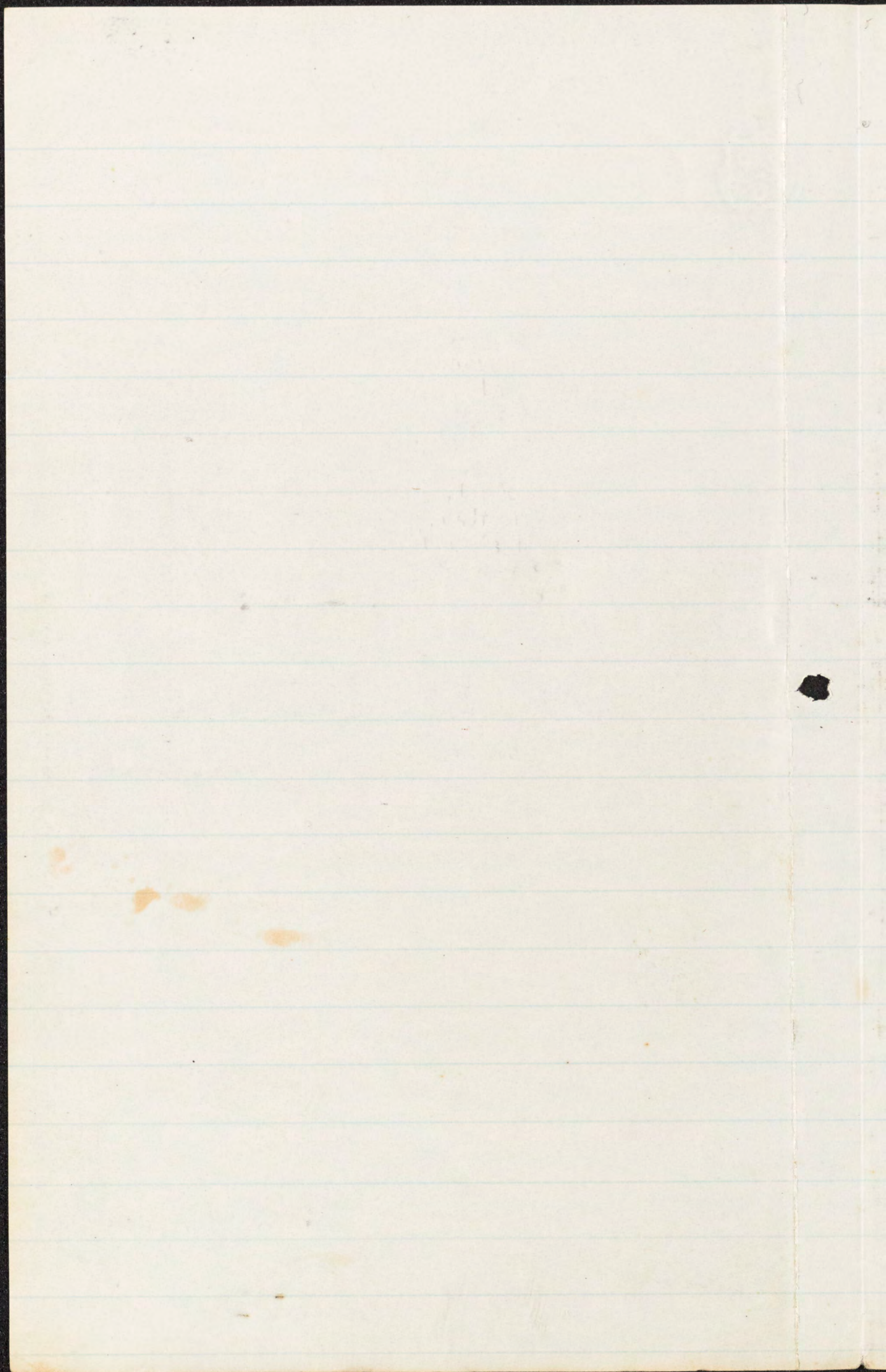
Hermann of Zürich
asserts external elevates
bony ribs, &
internal the
cartilages.



P.

(12)

Respiration concluded
& Animal Heat



inspiration is calculated to be equal to a weight of ~~two~~ ^{four} hundred pounds lifted.

and fifty

Changes of the Air Breathed.

Common air consists of about seventy-nine volumes of nitrogen, and twenty-one of oxygen; with about four parts in ten thousand of carbonic acid, a variable amount of watery vapor, and some non-essential gases and particles.

After passing through the lungs, a portion of air has become warmer; its *oxygen* is *diminished*, its *carbonic acid* and *watery vapor* *increased*. The increase of carbonic acid may be shown by the milky turbidness produced by breathing into clear lime-water. The vapor of water in the breath is made known in the open air on a cold day, by the cloud condensing near the nostrils or mouth.

For every thousand volumes of carbonic acid exhaled, Valentin and Brunner assert that over one thousand one hundred and seventy-four volumes of oxygen gas are absorbed into the blood. In an hour, 1583.6 cubic inches of oxygen are absorbed on the average. Pettenkofer has shown that more oxygen is absorbed at night than during the day.

Of carbonic acid, about 1345.3 cubic inches are given out every hour, containing one hundred and seventy-three grains of carbon; or eight ounces of carbon in twenty-four hours. The amount of this exhalation varies, however, with age, sex, temperature, and purity of the air.

From eight to thirty years of age, in males, the amount of carbonic acid exhaled increases; from thirty to forty it is nearly the same; after that time it diminishes gradually. In females, it is less than in males of the same age; it increases from eight years till puberty, and then remains stationary throughout the menstrual and child-bearing period of life.

The *faster* one breathes, the *less* is the proportionate amount of carbonic acid exhaled. As to *temperature*, between 38° and 75° Fahr., every rise of 10° is attended by a lessening in the carbonic acid given out, of two cubic inches per minute. *over 2 per cent*

old

An atmosphere containing five or six per cent. of carbonic acid gas is not capable of long sustaining life. Ten per cent. may produce immediate danger. While pure carbonic acid is irrespirable, its dilution causes it to be tolerated by the breathing organs. Hence the peril of life in some deep wells, brewers' vats, and rooms in which charcoal is allowed to burn without ventilation.

The use of *food* increases the amount of carbonic acid in the air expired. *Alcoholic* drinks diminish it. *Exercise* increases it. Sleep diminishes it.

The amount of *watery vapor* exhaled from the lungs is, on the average, a pint in twenty-four hours.

(about 10 ounces)

nearly

Changes Produced by Respiration in the Blood.

The *color* of the blood is altered in the lungs, from dark crimson or purple to bright scarlet. The blood is also 1° or 2° warmer;¹ it contains *more oxygen, less carbonic acid*, and more fibrin. The introduction of oxygen gas, and the elimination of carbonic acid gas, are, as already observed, the two great purposes of respiration. Venous blood is that which has been, by various influences during its flow, rendered unfit for the support of vital energy. Arterial blood has been revived by its purification and oxygenation.

When these changes are prevented, as in strangulation, drowning, or *asphyxia* by irrespirable gases, the dark blood is unable to maintain the vitality of the nerve-centres; and the blood ceases even to flow through the vessels. Drowning occurs, therefore, not from any directly injurious effect of the water in the lungs, but from the simple exclusion of air. ~~So~~ in some of the deaths from inhalation of chloroform, the cause probably has been the deficient admixture of air with the anæsthetic. That substance is, however, capable of causing fatal arrest of respiration, apparently by its toxic influence upon the *medulla oblongata*, the nerve-centre of respiration. *Shorter time in drowning, according to experiments,*

Recovery from drowning seldom occurs when the individual has been submerged as long as five minutes. Rare instances are narrated, in which it has been fifteen minutes. Even practised pearl-divers can seldom stay under water for one whole minute at a time.

Animal Heat.

In the armpit, or under the tongue, the temperature of the adult human body is, in health, $98^{\circ}.4$ or $98^{\circ}.5$ Fahr. The heat of the blood is 100° to 101° . Children have a temperature two or three degrees higher. In disease, especially in scarlet fever and yellow fever, it has been known to reach 108° , and, it is said, $112^{\circ}.5$. Cholera, pernicious fever and *cyanosis* are attended by depression of temperature.* In cholera, it has gone down during life to 77° . Other parts of the body are cooler than the armpit; the sole of the foot does not average in health above 90° . During sleep, the heat of the body goes down about $1\frac{1}{2}$ degrees. It is highest early in the morning, fluctuates through the day, and is lowest about midnight. Exercise elevates it considerably; eating does so to a less extent. The reaction following a cold bath may raise it one degree or more.

As we are constantly giving off heat by radiation, conduction, and evaporation to surrounding bodies, it must be supplied by processes going on within the system. The explanation long held

undermined by cancer, low.
This is not admitted by all observers.

* 71.8° recovered from, fell into hole in ice, Lond. Med. Rec, Oct. 29. 73

12 hours left - enough to look for 6 months
5/6/70 -

than when water pipe is muffled by cloth.
Teale, 120! 1875.

Döhrhoff's

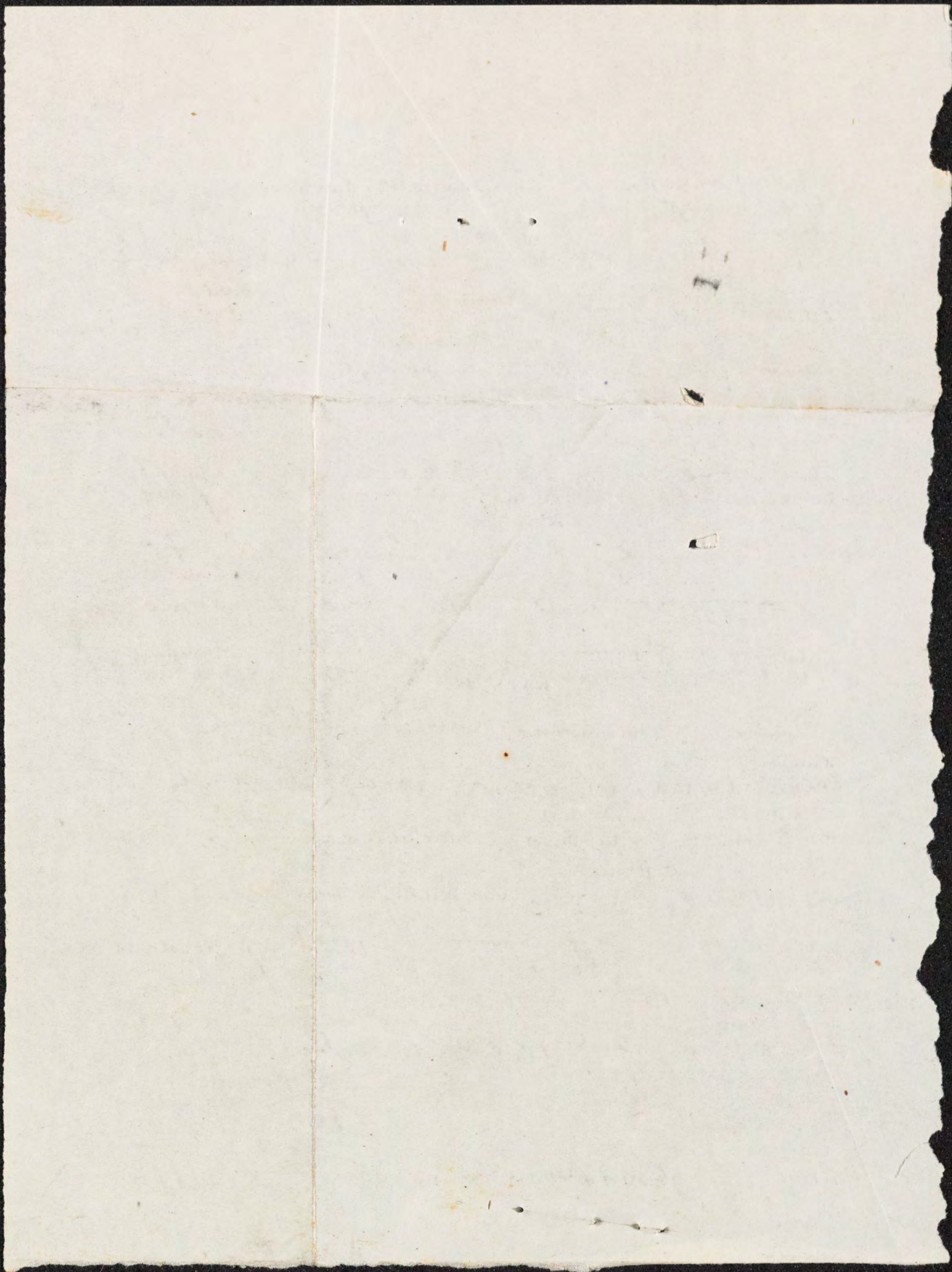
These experiments show that cold-blooded animals behave like plants with regard to freezing temperatures. They die, like these, at different freezing temperatures. The honey-bee dies at -1° ; the spider at -3° ; the flesh-fly survives a temperature of -6° ; the silkworm egg one of -21° . And as there are plants in which the water may be frozen without their dying, there are some animals in which this occurs. In leeches a part of the contained water may be frozen; the silk-worm egg may be frozen solid, without life being extinguished.

In the spiders and flies exposed to freezing temperature a part of the water was frozen; but as contraction of the muscles still took place in a temperature at which pieces of meat were frozen stiff, it is improbable that their muscles were frozen. The freezing of the water in leeches puts an end to all motion. They move at 0° but at $-1\frac{1}{2}^{\circ}$ are quite still. 1873.

a short time after putting on the
iar eruption of an irritating nature appeared on
that portion of the body covered by the cloth.
The effects were not merely local, but to a con-
siderable extent constitutional, pain and uneasi-
ness being experienced in the back and lower
extremities. In proof that the eruption was
caused by the dye colors, it may be stated that
a portion of the garment about the upper part
of the chest was lined with linen on the under
side, and wherever this came in contact with the
skin, no eruption or redness appeared. The
gentleman had worn cotton stockings, upon the
upper portion of which there was woven into
the fabric a narrow line of red. Beneath this
band of red around the leg, appeared a corre-
sponding band of irritated skin after wearing the
hose one day. The poisonous influence of the dye
colors in this case cannot be disputed. It is not
probable that the number of persons is large who
possess such idiosyncrasies of constitution as to be
affected by dye colors, but that there are



Even the lowest animals (proto-
zoa) seem to resist freezing awhile
by a heat of their own, scarcely sensible.
Heaps of snails, or earthworms, ^{may} have a temper-
ature 1° or 2° higher than the air around
them. Nursing bees in a hive sometimes ac-
quire a heat $22\frac{1}{2}^{\circ}$ above that of the air.
Fishes commonly have a temperature 1° or 2°
higher than the water they are in; some, as the
bonito and tunny, ^{one} yet more elevated. Rep-
tiles have somewhat warmer blood; but
the term cold-blooded is applied to them
as well as to fishes, because their animal
heat is much more easily reduced by ex-
posure to cold, than is that of mammals
and birds. Among mammals, the sheep averages
 104° ; the hog, 106° ; the Arctic fox, 107° .
With birds, it ranges from 100° in Sea-gulls,
to 110° in the common fowl, and 111° in the
swallow.



—Prof. Thiselton Dyer read the following extract from a letter addressed by Mr. W. H. Tillett to Dr. Hooker :—" April 26.—*Philodendron selloum* is now in bloom again. Last night I fancied it was emitting heat, and in testing this with a thermometer found it was so. The heat in the house was 58° F., and the thermometer rose at once to 68° F. I have tested it again this evening, and the thermometer rises from 58° F. to 74° F. April 27.—Testing the *Philodendron* last night, I found it was 35° F. above the temperature of the house. The house was 56° , and the flower—one newly opened— 91° ."—

Watson

June 11,

1874

to notice the application

—Prof. C. H. Hitchcock spoke of his studies of the Helderberg rocks of New Hampshire. He also described in detail the geology of the northern part of Grafton County, New Hampshire, where the Helderberg Rocks can be best studied.

PARIS !

Academy of Sciences, June 1.—M. Bertrand in the chair.
—M. Jamin presented the following paper in continuation of his researches on magnetism : On the part played by the mean

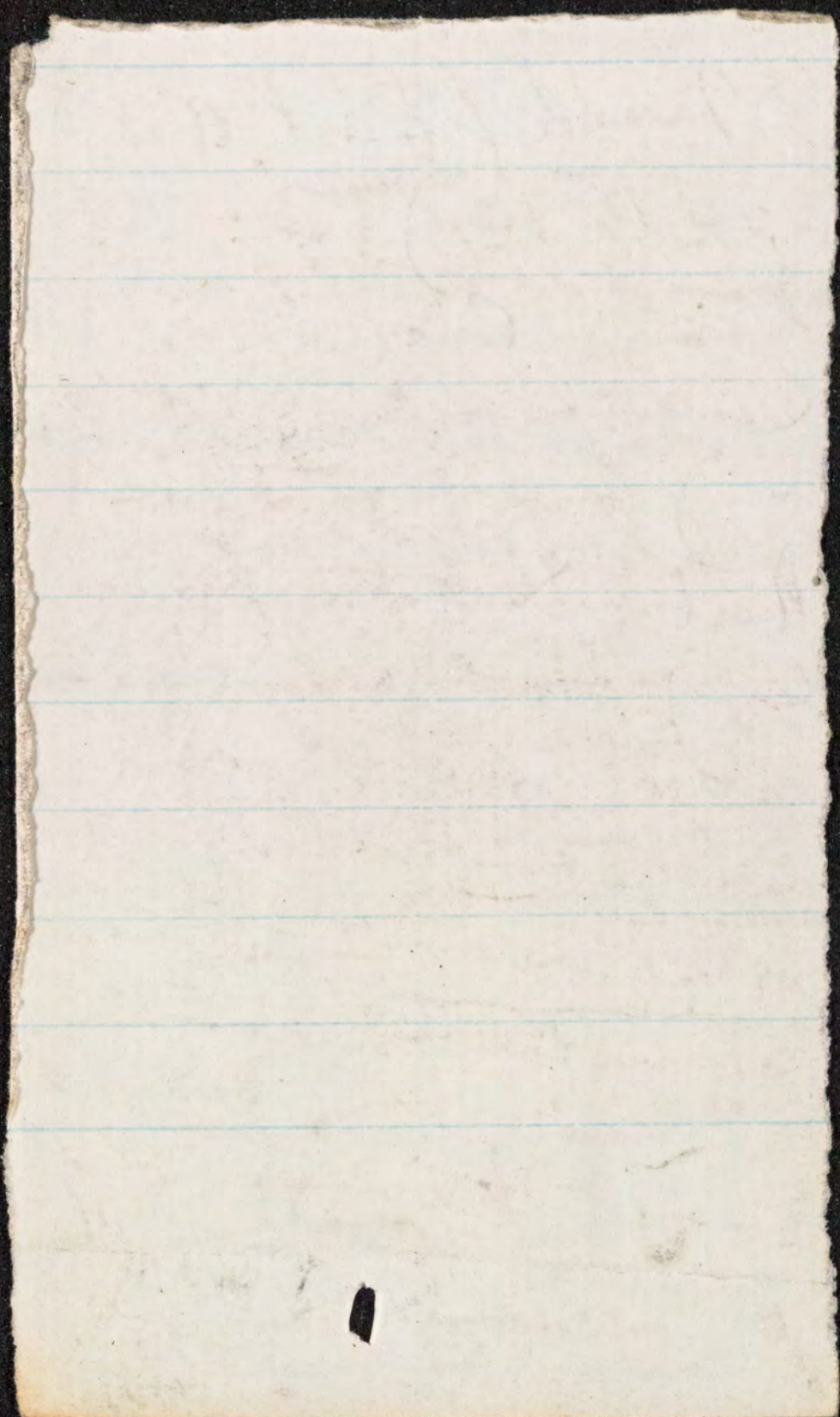
LOW TEMPERATURE FROM EXCESSIVE DRINK.—Dr. Shattuck (*Boston Medical Journal*) reports the case of a man who at one time drank *three champagne bottles full of brandy*; how much more is not known. Twenty-four hours after this spree he was found comatose in a freight-car. The temperature, taken in axilla and rectum, by at least two thermometers, was 76° Fahrenheit. Twelve hours afterwards it had come up to 91° Fahrenheit. He entirely recovered.—*Detroit Review of Medicine*.

Coffee memorandum
temperature, about 10°

ciable effect upon the brain, while opium induces a hyperæmia of that organ. 5th. Salicin possesses valuable antiseptic properties, while opium, if it possesses any, does so in a very feeble degree. 6th. Salicin is an antiperiodic, while opium has no notable effects in that direction. 7th. Salicin prevents the putrefactive changes in the contents of the bowel; opium does not.

CROUP AND DIPHTHERIA (*The Lancet*, June 19, 1875).
—Dr. Wm. Carr calls attention to the following case as aiding in establishing the proof that a primary fibrinous croup may exist which has nothing in common with diphtheria as an infectious disease, and which not un-

Dr Mendel (Virch. Archiv)
April 16, 1870) exper. with
thermom. in Cranial cavity
& another in section (Cats &
dogs) found temp. in
Rectum & brain tissue (general
temp.) lowered under chloroform,
chloral, morphia & alcohol.
Cephalic most reduced by all
except alcohol — under which
difference between head & rectum
was lessened, & not unfreq. the
cephalic became greater of
the two.



Temperature of animals: ⊕

Lombard's and other experiments on brain temperature: thought, & still more emotion, distinctly elevate the heat of the head; even 'hearing' warm poetry read.

* Depression of temperature also in cancer, uræmia, alcoholism,
going off of relapses & continued fevers, &c.

Drinking alcohol lowers it (Demarquay, Dumeril, Lichtenfels, Frölich, Bouvier, Anstie, Richardson)
Nearly a degree in 15 minutes, from a pint of beer,
Coffee & very strong tea raise the temperature;
 $\frac{3}{4}$ degree in an hour.

In continued fevers, with debility, alcohol
lowers the excessive temperature. Explain this.

